

**NIGHT VISION FOR YOUR CAR**

JUNE 1999

# **Electronics NOW**

## **PIRATE RADIO**

Are unlicensed broadcasters  
anarchists who need to  
be stopped, or a valuable  
community resource?

### ***The BreadBlox Prototyping System***

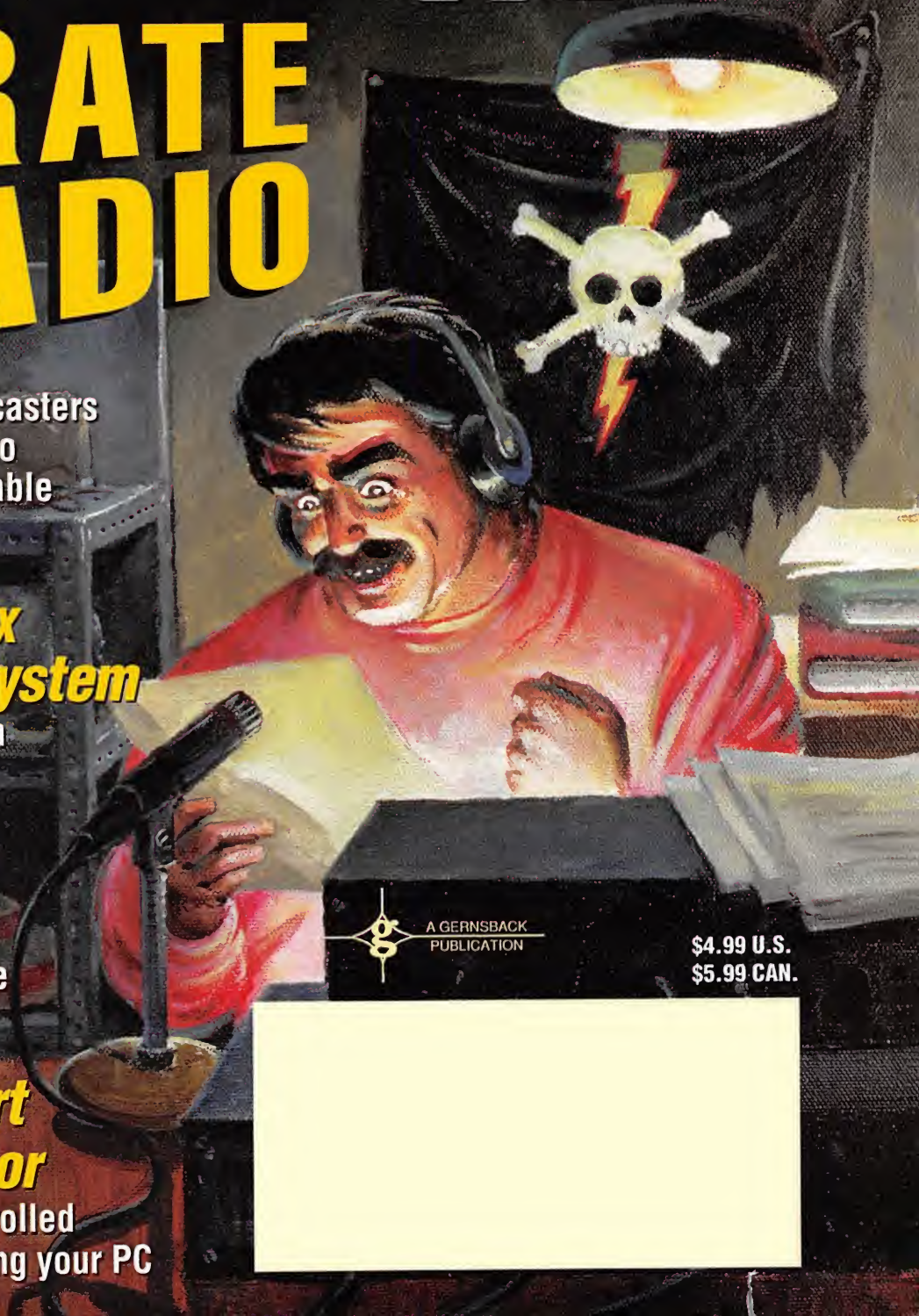
It makes circuit design  
easier than ever

### ***Build A Solar Dosimeter***

Monitor your exposure  
to sunlight

### ***A Parallel-Port Optical Isolator***

It keeps your PC-controlled  
projects from damaging your PC



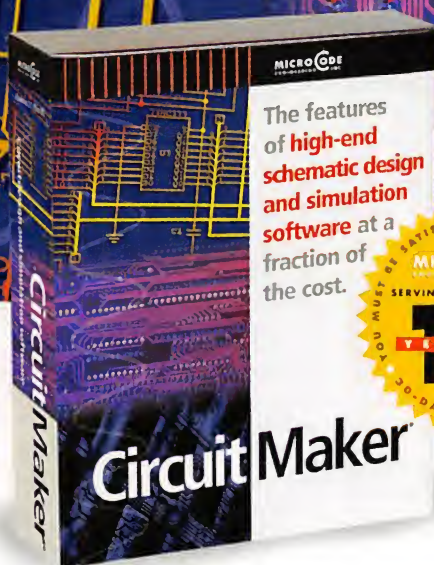
**\$4.99 U.S.  
\$5.99 CAN.**



# High-end features. Low-end price.

**\$299**

**CircuitMaker 6:**  
Schematic design  
and simulation  
software



**\$299**

**TraxMaker 3:**  
Printed circuit  
board layout  
software

*CircuitMaker Version 6 and TraxMaker Version 3 give you the features of professional, high-end software at a fraction of the cost. Plus, with exceptional ease-of-use you'll spend less time learning to use the software and more time designing. Both applications are compatible with your existing software, and feature outstanding technical support. **Call now for your free functional demo.***

## **CircuitMaker 6 is a powerful schematic design and simulation program featuring:**

- Professional schematic features including printout borders, title block and barred pin names
- Symbol editor and Macro feature for custom devices
- Fast, accurate SPICE3f5/XSPICE-based simulation
- Complete array of analysis types, including Fourier, AC, DC, Parameter sweep, Transient and more
- Virtual instruments including a digital oscilloscope, multimeter, Bode plotter, curve tracer and more
- Extensive library of over 4,000 models
- Tight integration with TraxMaker® for quick PCB layout
- Output PCB netlists in Protel®, Tango® and TraxMaker® formats for use in a variety of PCB layout programs
- Windows 3.1, 95 and NT

## **TraxMaker 3 is a powerful printed circuit board layout program featuring:**

- Over 2,000 component footprints in a fully-documented, indexed library. Documentation shows footprints actual size
- Built-in autorouter and Design Rules Check
- Supports up to 6 signal layers plus power and ground planes, silk screen overlays and solder and paste masks
- Board sizes up to 32" x 32", with no pin limitations
- Intelligent manual routing with unroutable capabilities
- Import any PCB netlist in CircuitMaker®, Protel® or Tango® format
- Output RS274X Gerber files, Excellon N/C drill files and Bill of Materials
- Print to any Windows-compatible printer or plotter
- Windows 3.1, 95 and NT

**MICROCODE**  
ENGINEERING INC

**For free demo software, or to order, call 1-800-419-4242**

927 West Center Street • Orem, UT 84057 • Phone (801) 226-4470 • Fax (801) 226-6532 • [www.microcode.com](http://www.microcode.com)



# CONTENTS

JUNE 1999

## ON THE COVER

### 27 Pirate Radio

You may have heard about radio pirates on the news or from an acquaintance, or you might have heard one of their broadcasts, but what is it that makes these clandestine broadcasters so interesting to listeners and the authorities? In this month's cover story, we take a behind-the-scenes look at the ever-changing world of unlicensed radio stations, the motivations of the individuals who run them, why they are so well loved by those who listen to them, why the government wants to shut them down at all costs, and where you can hear them for yourself. — *Andrew Yoder*



## BUILD THIS

### 34 Parallel-Port Optical Isolator

If you build or use computer-controlled circuits, you want one of these to protect your PC should something go wrong.  
— *Dave Sweeney*

### 41 The BreadBlox Prototyping System

These handy modules make the job of testing your circuit designs easier than ever. — *James Melton*

### 74 Build a Solar Dosimeter

Is your garden getting enough sunlight? Are you getting too much? Build this simple circuit and find out. — *Paul Neher*

## AND MORE

2 EDITORIAL

3 Q&A

7 LETTERS

16 NEW PRODUCTS

85 NEW LITERATURE

## TECHNOLOGY

### 17 Prototype

Finding the tiniest particle, fingerprint scanners, an Internet refrigerator, if rocks could talk, and more.

### 27 Night Vision for Your Car

Driving at night might become much safer thanks to this system that will be available in some cars beginning next year. — *Bill Siuru*

## DEPARTMENTS

### 10 EQUIPMENT REPORT

Canon PowerShot A5 digital camera and CD-200 digital printer.

### 12 COMPUTER CONNECTIONS

Lightning-fast on-line access.  
— *Konstantinos Karagiannis*

### 14 ANTIQUE RADIO

The evolution of the AC/DC set. — *Marc Ellis*

### 22 SERVICE CLINIC

Testing flyback transformers.  
— *Sam Goldwasser*

### 78 TECH MUSINGS

Twinkle, twinkle, little lights; PIC prototyping boards; and more. — *Don Lancaster*

88 ADVERTISING INDEX

88 ADVERTISING SALES OFFICE

As a service to readers, ELECTRONICS NOW publishes available plans or information relating to newsworthy products, techniques and scientific and technological developments. Because of possible variances in the quality and condition of materials and workmanship used by readers, ELECTRONICS NOW disclaims any responsibility for the sale and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

Since some of the equipment and circuitry in ELECTRONICS NOW may relate to or be covered by U.S. patents, ELECTRONICS NOW disclaims any liability for the infringement of such patents by the making, using, or selling of any such equipment or circuitry, and suggests that anyone interested in such projects consult a patent attorney.

ELECTRONICS NOW, (ISSN 1067-9294) June 1999. Published monthly by Gernsback Publications, Inc., 500 Bi-County Boulevard, Farmingdale, NY 11735-3931. Periodicals Postage paid at Farmingdale, NY and additional mailing offices. Canada Post IPM Agreement No. 334103, authorized at Mississauga, Canada. One-year subscription rate U.S.A. and possessions \$24.99, Canada \$33.15 (includes G.S.T. Canadian Goods and Services Tax, Registration No. R125166280), all other countries \$33.99. All subscription orders payable in U.S.A. funds only, via international postal money order or check drawn on a U.S.A. bank. Single copies \$4.99. © 1999 by Gernsback Publications, Inc. All rights reserved. Printed in U.S.A.

POSTMASTER: Please send address changes to ELECTRONICS NOW, Subscription Dept., Box 55115, Boulder, CO 80328-5115.

A stamped self-address envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.



Hugo Gernsback (1884-1967) founder

**LARRY STECKLER**, EHF, CET,  
Editor-in-chief and publisher  
**ADRIA COREN**, Vice President  
**KEN COREN**, Vice President

## EDITORIAL DEPARTMENT

**CARL LARON**, editor  
**JOSEPH J. SUDA**, technical editor  
**EVELYN ROSE**, assistant editor  
**MICHAEL A. COVINGTON**, N4TMI  
contributing editor  
**MARC ELLIS**, contributing editor  
**SAM GOLDWASSER**, service editor  
**KONSTANTINOS KARAGIANNIS**,  
computer editor  
**FRANKLIN J. MILLER**, audio editor  
**DON LANCASTER**, contributing editor  
**JANINE ABITABILE**, editorial assistant

## ART DEPARTMENT

**ANDRE DUZANT**, art director  
**RUSSELL C. TRUELSON**, illustrator

## PRODUCTION DEPARTMENT

**KEN COREN**  
director of desktop production  
**RUBY M. YEE**, production director  
**KATHRYN R. CAMPBELL**  
production assistant  
**MICHELE MUSÉ**  
production assistant

## CIRCULATION DEPARTMENT

**GINA GALLO**  
circulation director  
**CHRISTINA M. ESTRADA**  
circulation assistant

## REPRINT DEPARTMENT

**JANINE ABITABILE**  
reprint bookstore

Typography by Mates Graphics

**Electronics Now** is indexed in  
*Applied Science & Technology Index*,  
*Readers Guide to Periodical Literature*,  
*Academic Abstracts*, and *Magazine*  
*Article Summaries*.

Microfilm & Microfiche editions are  
available. Contact reprint bookstore  
for details.

## Advertising Sales Offices listed on page 88.

Electronics Now Executive and  
Administrative Offices

**1-516-293-3000.**

Subscriber Customer Service:

**1-800-288-0652.**

Order Entry for New Subscribers:

**1-800-999-7139.**

VISIT US ON THE INTERNET AT  
**www.gernsback.com**

# EDITORIAL

## Fips Lives!

As most readers of **Electronics Now** know, our parent company, Gernsback Publications, was founded by the legendary Hugo Gernsback. Hugo was an inventor, and innovator, a force in the electronics industry, and was the first to publish electronics magazines. He also was a man with an incredible sense of humor. One expression of that sense of humor was a series of articles published most Aprils under the pseudonym "Mohammed Ulysses Fips."

The Fips' stories, which first appeared in the 1930s, were clearly fictitious, with numerous technical giveaways scattered throughout, and they always ended with the words April 1, April First, or April Fools. Yet they were cleverly crafted, with just enough of an air of believability that some would miss the fact that it was a joke completely and either tried to build the described device or contacted the magazine to get more information. **Radio Craft** and **Radio-Electronics** magazines (this magazine's predecessors) would often get piles of mail from irate readers who "fell for the gag." A booklet, *The Collected Works of Mohammed Ulysses Fips*, remains a popular item in our Reprint Bookstore.

Though we lost Hugo many years ago (he passed away in the late 1960s), we've tried to keep some of the values and traditions of his magazines going as best we could. One of those traditions was the April Fools' articles. The sad fact is, however, there are few writers who could spin a parody article with Hugo's flair. Some of the articles worked; more didn't. In the last several years, we've only done a handful of the April Fools' stories (sometimes nothing more than a fictitious product announcement) between the two magazines we publish (**Electronics Now** and **Popular Electronics**). The reason was simply a lack of suitable material.

Then, lo and behold, a gem appeared. It was "The EC909-12 Analog Microprocessor" by Ken Kemski (April 1999). When we saw the piece, we knew it was perfect. Unfortunately, we did not fully realize how perfect!

Let's just say that the spirit of Fips has been reborn—with a vengeance! While most saw through the gag, and we got some really funny reader responses in reaction, more than a few fell for it completely. We really felt there were enough big, red, technological stop signs in this story that everyone would realize it was a put-on by the end, but it seems that many were so caught up in the incredible (and we do mean incredible!) advances that this fictitious processor promised that they ran right through all of them. We have been deluged by those looking for more information. Fortunately, most took it well when they realized they'd been had. A few weren't as forgiving, and we do sincerely regret any discomfort we caused anyone.

Oh, and by the way, there were also a couple of "suspect" items in April's "Prototype" section.

A cross section of reader reaction to the story appears in this month's "Letters" column. Our only problem is what will we do for an encore?



Carl Laron  
Editor





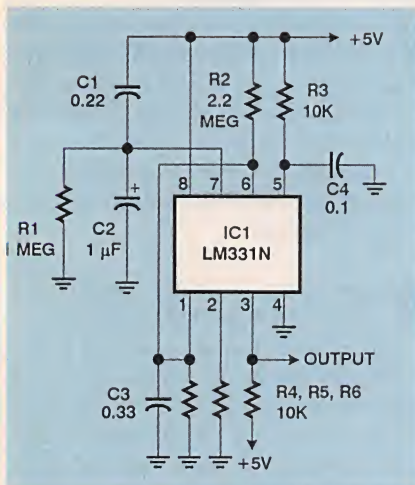
# Q & A

READERS' QUESTIONS, EDITORS' ANSWERS  
CONDUCTED BY MICHAEL A. COVINGTON, N4TMI

## Gently Falling Frequency

**Q** I need a design for an oscillator circuit, preferably 555-based, that will start out at approximately 500 Hz and decay to 0 Hz over a period of eight to ten seconds while maintaining an amplitude high enough to drive other digital ICs. Any help you could give would be greatly appreciated.—J. A. S., Smyrna, GA

**A** This is not easy to do with a 555 (I won't say impossible, because next month I'll probably hear from someone who has done it!). Figure 1 shows how to do it with an LM331N voltage-controlled oscillator. The frequency of oscillation is set by R3, C4, and the control voltage at pin 7. When you apply power, C1 and C2 charge, with most of



**FIG. 1**—THE OUTPUT FREQUENCY OF this oscillator falls from 500 Hz to 0 Hz, reaching a steady +5 volts after several seconds.

the voltage ending up on C1; pin 7 reaches about 1 volt and the oscillator runs at 500 Hz. Immediately, C2 starts discharging through R1, and the frequency drops over a period of several seconds, until oscillation stops completely with the output high (+5V). Connected to a speaker, this gives a nice

“Eeeeeeeuuuuwww...pop...pop...pop” sound effect, and it's fully compatible with TTL and CMOS logic circuits. If you're not driving logic chips, the supply voltage doesn't have to be exactly 5 volts.

The purpose of R2, which you won't find in most LM331N circuits, is to bias the voltage-controlled oscillator slightly so that the oscillation will definitely stop when the input voltage falls to zero, rather than continuing at a very low frequency. Resistor R6 is the pull-up resistor for the open-collector outputs. For the functions of the other components, see the LM331N data sheet (available online at [www.nsc.com](http://www.nsc.com)).

Another way to get a falling frequency is to program a microcontroller to toggle an output bit at a steadily decreasing rate. Figure 2 shows pseudocode (an English-like outline of a computer program) indicating how this might be done. We'd appreciate feedback from readers as to whether pseudocode is a good way of documenting microcontroller software; the actual assembly code would be much longer and harder to read and would apply to only one type of CPU.

The key idea is to delay N milliseconds between output transitions, where N is a steadily increasing number, and then stop altogether when N gets high enough. As shown, the program takes 10 seconds to stop, but the frequency decrease is nonlinear; the frequency drops very rapidly at first, then slowly trails off. Instead of just adding 2 to N each time, you might want to compute something like:

If  $N > 8$  then  $N := N/8$  else  $N := N+1$

so that the increase in N is proportional to N itself. Note that  $N/8$  is easy to compute in binary; all you do is shift the number 3 bits to the right. However, if you start with a number less than 8, you get zero, and in that situation, it's necessary to add 1 rather than 0, or N will

never change and you'll be stuck. Or you can compute a more complicated function and make the frequency fall exactly the way you want. You could even use a memory lookup table for a series of steadily increasing time delays.

```
N := 1;
A: Delay N milliseconds;
Toggle output bit;
N := N + 2;
If N < 200 then go to A;
Stop.
```

**FIG. 2**—HERE'S THE PSUEDOCODE for a microprocessor program to generate a signal whose frequency gradually falls to zero.

Since it only needs one output pin, this application might be a good job for one of the new low-cost 8-pin PIC microcontrollers (PIC12C508 and the like). Microchip Technology has just announced an 8-pin PIC with an on-board voltage regulator so that it doesn't need a 5-volt supply. Information is available online from [www.microchip.com](http://www.microchip.com) or by writing to Microchip Technology, Inc., 2355 W. Chandler Blvd., Chandler, AZ 85224.

## Mystery Outlet

**Q** I have a digital electric alarm clock that began gaining time. I wrote it off to a lightning hit we took a few weeks ago and bought a new one. I plugged it in and it, too, ran about 25% fast. I then plugged both clocks into other outlets in the same room and they both are working correctly. I am completely baffled. Do you have any ideas?—R. E. S., Watkinsville, GA

**A** Two words: *electrical noise*. As shown in Fig. 3, a line-powered digital clock keeps time by counting cycles of the 60-Hz AC power. (This is normally more



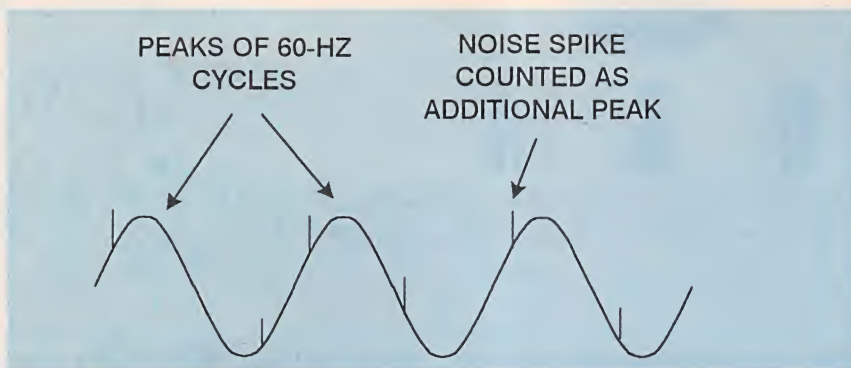


FIG. 3—NOISE SPIKES in the electrical power lines could make a digital clock run fast.

accurate than using a quartz crystal.) Apparently, your power line has some noise spikes on it that are occasionally being counted as extra cycles. This may have started when the lightning strike took out some protective capacitors or MOVs inside another appliance nearby, probably either a light dimmer or something involving an electric motor. Connecting an oscilloscope to the line through an isolation transformer would give a definite answer; you might also try unplugging appliances that might be the source of the noise.

## Cheap, Precise 0.5-Hz Oscillator

**Q** I'm sure many people could use a cheap, \$2, thrift-store pulse frequency standard. I bought a battery-powered quartz-controlled clock with an analog dial, removed the 390-ohm coil, and replaced it with a 390-ohm resistor. I got a waveform of alternating 0.7-volt pulses (Fig. 5, upper trace). Is there some way I could get all positive-

going pulses?—C. R., Matthews, NC

**A** I tried the same thing, using an old Copal analog-dial quartz clock (vintage 1980). Clocks of this kind are driven by an electromagnet (coil) that gets a pulse of current once per second, moving the analog mechanism along every time it does so. I found that I could get a stronger signal by removing the coil altogether, rather than replacing it with a resistor. I then got 1.5-volt-high pulses.

One way to convert this into logic-level pulses is shown in Fig. 4. Resistors R1 and R2 raise the baseline voltage of the signal to 2.5 V. Then it swings from +1.0 to +4.0 V instead of -1.5 to +1.5. This signal is fed into a 555 timer IC, which changes state when its input swings above  $\frac{1}{3}$  or below  $\frac{1}{3}$  of the supply voltage. The result is a 0.5-Hz square wave.

If you want one pulse per second, rather than one every two seconds, use two comparators as shown in Fig. 6. Be sure to use comparators that have open-collector outputs, not op-amps, so that the outputs can be tied together in the manner shown. This circuit is known as a

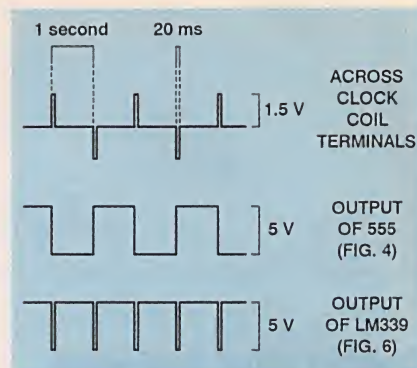


FIG. 5—THE UPPER TWO WAVEFORMS are taken from across the clock-coil terminals and at the output of the 555 in Fig. 4. The bottom waveform is from the output of the 555 in Fig. 6.

"window comparator"—it detects whether or not the signal voltage falls within a small "window" around 2.5 V. Specifically, whenever the voltage on pins 4 and 7 swings either higher than pin 5 or lower than pin 6, the output goes low. Thus, you get a logic-level pulse for every cycle of the clock oscillator.

## And Speaking Of Quartz Clocks...

**Q** I would be very glad if you could identify a replacement for an IC designated HD44001; this chip is from an analog clock in an automobile. It's a 16-pin DIP with a 4914.5-kHz crystal across pins 9 and 10; pins 14 and 16 connect to a solenoid that operates the clock mechanism.—G.C.T., Sayao, Philippines

**A** There is no HD44001 listed in the standard ECG or NTE replacement cross-reference indexes, nor even in the online IC Master ([www.icmaster.com](http://www.icmaster.com)). I fear what you've run into is "house numbering"—the clock manufacturer bought a large number of chips and had them labeled with his own part number, rather than the manufacturer's standard one.

Not all ICs are available in small quantities to individuals. This isn't a general-purpose IC like op-amps, voltage regulators, or microcontrollers; nor is it part of something that is likely to be repaired on the component level, such as a TV or stereo system. Few people take their analog clocks to the repair shop. Accordingly, this chip probably isn't stocked by distributors at all; it goes straight from the chip maker to the clock maker, and that's probably who

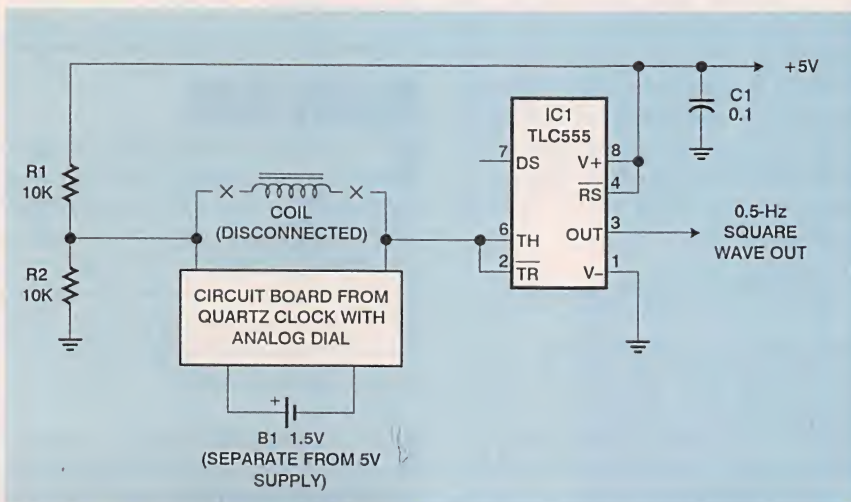
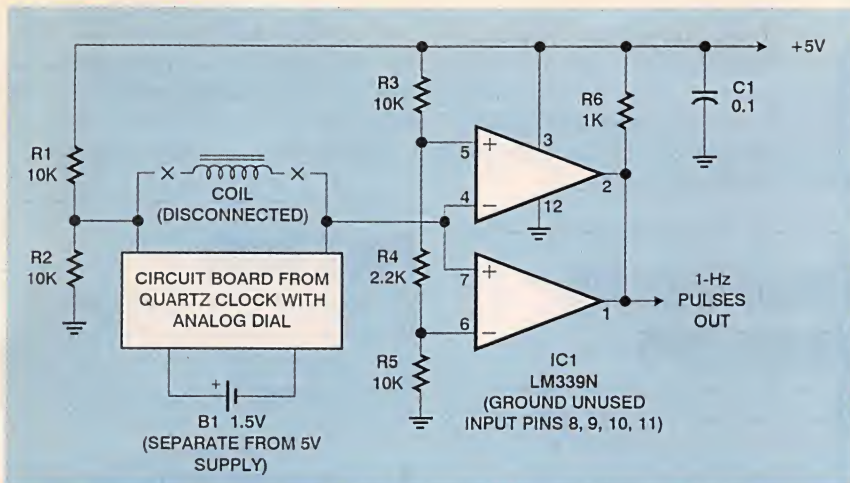


FIG. 4—THIS SCHMITT-TRIGGER CIRCUIT converts a standard clock circuit into a digital time base.





**FIG. 6**—THIS WINDOW COMPARATOR generates 1-Hz logic-level pulses from a standard clock circuit.

you'll have to contact to get a replacement. Or a reader may recognize it as equivalent to a chip sold under another name. Readers?

## Calling Beckman...

**Q** I have a Beckman Industrial digital multimeter, model DM 800. It needs repair, but my letter to Beckman's address in Brea,

California, was returned by the Postal Service. Can you tell me the present address?—E. B. C., Chestertown, MD

**A** Certainly. Beckman's test equipment line has been acquired by Wavetek, Wandell & Goltermann Inc., whom you can reach at 9045 Balboa Avenue, San Diego, CA 92123, Web: [www.wavetek.com](http://www.wavetek.com); e-mail: [testsupport@wavetek.com](mailto:testsupport@wavetek.com); Tel: 619-279-2200. They still make the

same fine products, as well as many new ones.

A couple of years ago I accidentally fried my Beckman DM25L by connecting it to a high voltage, and to my delight, all the internal parts turned out to be replaceable—not one of them was a custom IC, and there was even a schematic in the instruction leaflet. All I had to do was put in some new op-amps, re-do the calibration, and the meter worked fine. Clearly, this instrument was designed to be repaired, a rare feature nowadays. The display and the selector switch are presumably custom items, since they could hardly be otherwise, but almost everything else is a standard industrial component.

## Checking Flybacks

**Q** Can you tell me where I can find information about how to check a flyback transformer from a TV set?—W. R., London, Ontario, Canada

**A** There's a web page on this very subject at [www.repairfaq.org/REPAIR/F\\_flytest.html](http://www.repairfaq.org/REPAIR/F_flytest.html), which is part of a large

## HOW TO GET INFORMATION ABOUT ELECTRONICS

**On the Internet:** See our Web site at <http://www.gernsback.com> for information and files relating to our magazines (**Electronics Now** and **Popular Electronics**) and links to other useful sites.

To discuss electronics with your fellow enthusiasts, visit the newsgroups [sci.electronics.repair](mailto:sci.electronics.repair), [sci.electronics.components](mailto:sci.electronics.components), [sci.electronics.design](mailto:sci.electronics.design), and [rec.radio.amateur.homebrew](mailto:rec.radio.amateur.homebrew). "For sale" messages are permitted only in [rec.radio.swap](mailto:rec.radio.swap) and [misc.industry.electronics.marketplace](mailto:misc.industry.electronics.marketplace).

Many electronic component manufacturers have Web pages; see the directory at <http://www.hitex.com/chipdir/>, or try addresses such as <http://www.ti.com> and <http://www.motorola.com> (substituting any company's name or abbreviation as appropriate). Many IC data sheets can be viewed online. [www.questlink.com](http://www.questlink.com) features IC data sheets and gives you the ability to buy many of the ICs in small quantities using a credit card. You can also get detailed IC information from [www.icmaster.com](http://www.icmaster.com), which is now free of charge although it formerly required a subscription. Extensive information about how to repair consumer electronic devices and computers can be found at [www.repairfaq.org](http://www.repairfaq.org)

**Books:** Several good introductory electronics books are available at RadioShack, including one on building power supplies.

An excellent general electronics text-

book is *The Art of Electronics*, by Paul Horowitz and Winfield Hill, available from the publisher (Cambridge University Press, 1-800-872-7423) or on special order through any bookstore. Its 1125 pages are full of information on how to build working circuits, with a minimum of mathematics.

Also indispensable is *The ARRL Handbook for Radio Amateurs*, comprising 1000 pages of theory, radio circuits, and ready-to-build projects, available from the American Radio Relay League, Newington, CT 06111, and from ham-radio equipment dealers.

**Copies of past articles:** Copies of past articles in **Electronics Now** and **Popular Electronics** (post 1994 only) are available from our Claggg, Inc., Reprint Department, P.O. Box 4099, Farmingdale, NY 11735; Tel: 516-293-3751.

**Electronics Now** and many other magazines are indexed in the *Reader's Guide to Periodical Literature*, available at your public library. Copies of articles in other magazines can be obtained through your public library's interlibrary loan service; expect to pay about 30 cents a page.

**Service manuals:** Manuals for radios, TVs, VCRs, audio equipment, and some computers are available from Howard W. Sams & Co., Indianapolis, IN 46214 (1-800-428-7267). The free Sams catalog also lists

addresses of manufacturers and parts dealers. Even if an item isn't listed in the catalog, it pays to call Sams; they may have a schematic on file which they can copy for you.

Manuals for older test equipment and ham radio gear are available from Hi Manuals, P.O. Box 802, Council Bluffs, IA 51502, and Manuals Plus, P.O. Box 549, Tooele, UT 84074.

**Replacement semiconductors:** Replacement transistors, ICs, and other semiconductors, marketed by Philips ECG, NTE, and Thomson (SK), are available through most parts dealers (including RadioShack on special order). The ECG, NTE, and SK lines contain a few hundred parts that substitute for many thousands of others; a directory (supplied as a large book and on diskette) tells you which one to use. NTE numbers usually match ECG; SK numbers are different.

Remember that the "2S" in a Japanese type number is usually omitted; a transistor marked D945 is actually a 2SD945.

**Hamfests (swap meets) and local organizations:** These can be located by writing to the American Radio Relay League, Newington, CT 06111; (<http://www.arrl.org>). A hamfest is an excellent place to pick up used test equipment, older parts, and other items at bargain prices, as well as to meet your fellow electronics enthusiasts—both amateur and professional.



## Accredited B.S. Degree in Computers or Electronics

by studying at Home

Grantham College of Engineering  
offers 3 distance education programs:

- B.S.E.T. emphasis in Electronics
- B.S.E.T. emphasis in Computers
- B.S. in Computer Science

**NEW** -Electronics Workbench Professional 5.0  
included in our B.S.E.T. curriculums  
-Approved by more than 200 Companies,  
VA and Dantes, (tuition assistance avail.)

For your free catalog of our programs dial

**1-800-955-2527**

<http://www.grantham.edu>

**GCE**

Your first step  
to help yourself  
better your future!



Grantham College of Engineering  
34641 Grantham College Road  
Slidell, LA 70460-6815

Some Say Watching Tropical  
Fish Lowers Blood Pressure  
& Relieves Stress...



They Could Be On To  
Something.



Discover the Caribbean aboard a Tall Ship.  
6 & 13 day adventures from \$650.  
For more information call your travel agent  
or 1-800-327-2601.



**Windjammer**  
**Barefoot Cruises**

P.O. Box 190120, Dept. 5569 Miami Beach, FL 33119

library of repair information maintained  
by our Service Clinic columnist, Sam  
Goldwasser. By coincidence, that is also  
the topic of this month's installment of  
Service Clinic, which can be found else-  
where in this issue.

## Thomas Organ And Vacuum Tubes

**Q** I have a Thomas model AL-2 organ dat-  
ing from the 1960s and need to get it  
repaired. Do you know where I can obtain  
schematic and troubleshooting advice? Also,  
where can I obtain a vacuum tube manual  
like they used to have in the past, showing  
the elements and pin connections of tubes?—  
E. C., Coventry, RI

**A** The tube manual is easy—get in  
touch with Antique Electronic  
Supply, 6221 S. Maple Ave., Tempe, AZ  
85283; Tel: 602-820-5411. They sell  
reprints of tube manuals as well as plen-  
ty of tubes and other old-style parts.

According to his Web page, you can  
get technical information, service manu-  
als, and advice from Paul E. Doerr at

ORGAN-ized Services, Inc., Tel: 609-  
387-2633; Web: [www.organizedservices.com](http://www.organizedservices.com) (no mailing address given). Read the  
Web page first—it's packed with informa-  
tion about electronic organs of all types.

## Play It Slowly

**Q** Is there an easy way to slow a cassette tape  
recorder's speed down by half? My wife  
receives books on tape, recorded at half speed,  
from the National Library for the Blind.—  
M. M., Elko, NV

**A** If you slow the motor down electri-  
cally, it won't have very much torque.  
Instead, change the size of one or more  
pulleys in the drive system. You can sal-  
vage a pulley from another tape  
recorder, find one at a hobby shop, or  
even reduce the size of an existing pulley  
by filing or grinding it.

## Minding Our Bs And Hs

**Q** The web address for closed-caption decod-  
ing information that you gave in your  
October column, [www.broubaba.com/](http://www.broubaba.com/)...,  
doesn't work.—S. B., Mississauga, Ont.,  
Canada

**A** Well... it was the November column,  
not October, and the address was  
broubaba (with one B and two H's). The  
full address is: [www.brouhaha.com/~eric/pic/caption.html](http://www.brouhaha.com/~eric/pic/caption.html), and as of this  
writing it still works, although of course  
we have no control over it.

## Writing to Q&A

As always, we welcome your ques-  
tions. The most interesting ones are  
answered in print. Please be sure to  
include plenty of background informa-  
tion (we'll shorten your letter for publi-  
cation) and give your full name and  
address (we'll only print your initials). If  
you are asking about a circuit, please include  
a complete diagram. Due to the volume of  
mail, we regret that we cannot give per-  
sonal replies. Send to Q&A,  
Electronics Now Magazine, 500 Bi-  
County Blvd., Farmingdale, NY 11735.  
Questions can also be e-mailed to  
[q&a@gernsback.com](mailto:q&a@gernsback.com), but please do not  
expect an immediate reply (being a  
monthly magazine, we have to maintain  
a backlog) and please don't send graph-  
ics files larger than 100K.

EN

**POPTRONIX®**

Online  
Edition

We're on the web

**FREE**

We are starting up,  
but you can watch us grow!

Projects for beginners  
to experts!  
New Product information!  
Bookstore—discover  
what's new!

<http://www.poptronix.com>

**WE'RE WITH YOU EVERY DAY  
24 HOURS A DAY! DROP IN!  
WE'D LOVE TO HAVE YOU VISIT!**





# LETTERS

SEND YOUR COMMENTS TO THE EDITORS OF ELECTRONICS NOW MAGAZINE

## Brainwave Correction

It has come to our attention that there was an error in the schematic diagram for the "Learn to Relax with a Brainwave Synchronizer" that appeared in the April 1999 issue. In Fig. 2, on page 30, a connection is shown between R1/R2/C1 and R3/R4/C2. There should not be any connection between the two nodes; C1 and R3 should not be connected together. If the unit is built according to the schematic, the oscillators will not work. The foil pattern for the PC board, on the other hand, is correct. We apologize for the error.—*Editor*

## Attenuator Series

It has come to our attention that there was an error in the schematic diagram for the "Build a Step Attenuator" that was published in the April issue. Although the text was correct in saying that the various attenuator circuits are wired in *series*, the drawing in Fig. 5 showed the circuits wired in *parallel*. A corrected schematic diagram is shown here as Fig. 1. We apologize for any confusion that arose from this error.—*Editor*

## SmartProbe Errors

It has come to our attention that there were two errors in the article "Test Digital Circuits with the SmartProbe" (*Electronics Now*, March 1999). In the "How It Works" section on page 45, column 3, the second sentence of the para-

graph that begins "The SmartProbe's tip is connected to one of the inputs on each comparator," the following sentence

should read "Note that two of the comparators ('a' and 'c') ..."

The second error is in the schematic diagram (Fig. 1) that appears on page 46. There should not be a connection between R2 and R3. All four comparators should have their outputs connected to the printer-port inputs the same way: a signal diode and a pull-up resistor.—*Editor*

## Excellent Review

Regarding the recent excellent review of The SoundSmith's new CDT-4 Automated Audio Tester "Equipment Report" (*Electronics Now*, April 1999), we would like to make the following comments:

The CDT-4 not only tests CD Players, CD ROMs, and DVDs, but also pre-amps, amplifiers, VCRs/Camcorders, DATs/Tape Decks, Tuners, or anywhere an analog signal can go. It can also be used to test complete computer systems, including hard drives, memory and sound cards for long-term integrity.

Now available as an accessory for the CDT-4 is our modified MP3 player for use as a signal source, eliminating the need to use a "known good" CD player as the source. While the suggested user price of the CDT-4 Automated Audio Tester is \$1099.95, we are pleased to continue our introductory price of \$749.95 until further notice.

We welcome customer inquiries at either our Web site: [www.sound-smith.com](http://www.sound-smith.com) or our toll-free number: 800-942-8009.

PETER LEDERMAN, President  
The SoundSmith Corporation

## April Fooled

I read the entire article "The EC909-12 Analog Microprocessor" (*Electronics Now*, April 1999) by Ken Kemski (although I stumbled over the part where it describes the amount of light output versus energy input—didn't that

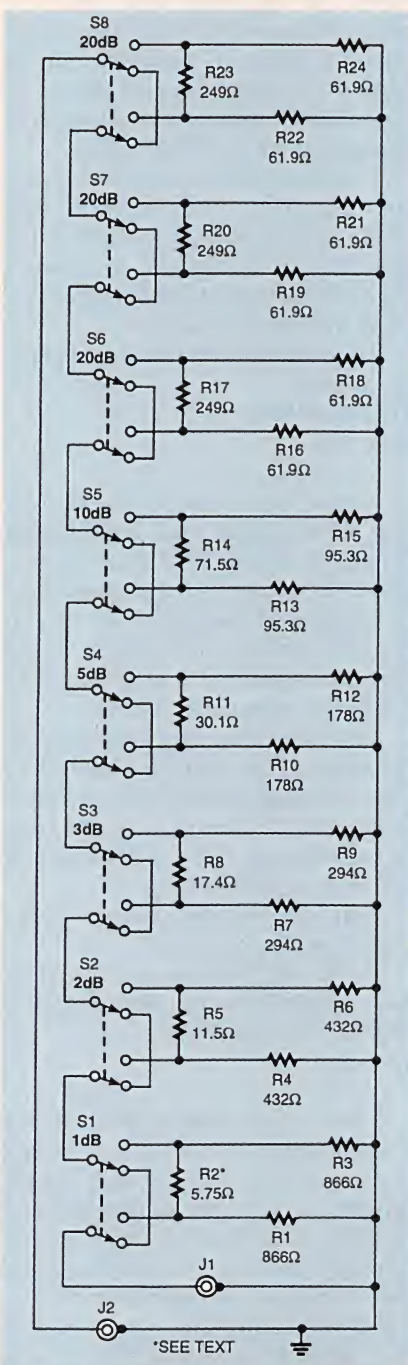


Fig. 1.

Write To:  
Letters,  
Electronics Now Magazine,  
500 Bi-County Blvd.,  
Farmingdale, NY 11735

Due to the volume of mail we receive, not all letters can be answered personally. All letters are subject to editing for clarity and length.



violate physical laws—but I wanted to believe). After all, I was excited: A microprocessor that fit into a Pentium II slot, ran at the equivalent of 900,000 MHz, allowed you to turn a 4 GB hard drive into a 16,000 GB hard drive and allow gigabytes of RAM!?!?!? Then I thought—this is too good to be true. Finally, I noticed the last sentence: “The scheduled release date is April 1.” I checked out the name of the company: Ecraf (“pronounce EK-raff”); spelled backwards “farce.” And I thought: YOU GOT ME!

Cheers.  
STEVEN ALEXANDER  
via e-mail

Nice article in your April edition about the EC909-12. I fell out of my chair laughing.  
BRIAN COVERSTONE  
via e-mail

Great article! I actually spent half an hour desperately searching the Internet for Ecraf Technology Corp. until I came to the slow realization that this was an April Fools’ joke.  
DAVID EISENBERG  
via e-mail

While you people may think it funny, I just can’t see the humor in your April Fools’ article about the analog processor. The reason that I bought your magazine was to try and find out about this device. I feel that you owe me my money back for printing this pack of lies called informational journalism.

If this is true, please tell me where to contact this company. If this is not true, I want my money back!  
JAMES SMITH  
via e-mail

Could the “Ecraf” Barrier Reflex Diode possibly be a “Farce” diode spelled backwards? Barrier Reflex Diode. Can’t think of a reason for that name. Apparently, no one else can either.

900 GHz speed? Will it wash my floors and do my laundry and cook my food for me too? Enough power to light a room at 1.2V and MICRO amps!!

Loved it. Great article. Nice to see SOMEONE has a sense of humor.  
JACK DONOGHUE  
via e-mail

I wonder how many people are going to order the analog processor that was in

your magazine. I would sure like to have their names. I have some beach front lots for sale in Oklahoma, also for \$12 apiece. (Same price as processor.) Thanks for the informative article.  
URA FARCE  
via e-mail

I was really taken by the article “The EC909-12 Analog Microprocessor” in the April issue. Can you send me any information you have about this company (Ecraf Technology Corp.) or if not I would like to get in touch with the author of the article Ken Kemski. I represent a financial investment group looking to invest a sizable amount in new technologies. Our typical minimum investments are over \$500 million.

I understand that on many occasions your magazine conducts in-house tests of the devices that are featured in the monthly issue. I would like to request a copy of any tests that you have conducted on this particular device.

An immediate response is greatly appreciated.  
SLOOF LIRPA  
via e-mail

I find it very offensive to hear that you have placed a bogus article in celebration of April Fools’ Day. With all the information out there that technical people have to scan through, we should not have to deal with this type of behavior. I have always considered you to be a serious magazine. I must reconsider that.

I have decided to stop purchasing your magazine and have sent this message to all other technical students here at Florida International University, so that they may do the same and find a publication that will not waste their time.

Your publication is a disgrace to the profession. Shame on you.

By the way, I got the joke: “Ecraf” is farce spelled backwards. How original!  
ROBERT BARRUECO  
via e-mail

I was very disturbed to learn that the Ecraf brothers are marketing a product that was developed by our firm. Let me explain. We hired the duplicitous Ecraf brothers as acrobats to entertain our employees at lunch. Unbeknownst to us, they were in our labs copying our designs, while we thought they were changing their tights. It should have been obvious to us that acrobats do not have to change clothing so often, but we were told that

something in the water here was causing them intestinal distress, and so we allowed them free access to our facilities for over six months. Now, we find that they are attempting to pass off our EC909-12 as their own product.

The public needs to know that the dangers of the Barrier Reflex Diode (BRD) are not fully understood at this time even by our own researchers. This product has caused several cases of spontaneous combustion in our labs and would be very dangerous in the wrong hands. As to the so-called “Drs. Ecraf,” please be advised that none of these men even has the US equivalent of a grammar school education, much less advanced degrees. These men are circus acrobats, good ones I have to admit, but certainly not capable of understanding or controlling the astonishing power of the EC909-12.

In addition, since it was not mentioned in your article, your readers need to be advised that further development in our labs has produced the Forward Access Time Termination Interface (FATTI) that returns the answer to the requested instruction prior to the completion of the request itself. We consider this the key to use of the EC909-12. The ability to anticipate what it is being asked to do makes it even more powerful than the best digital processors.

In the future, please get your facts straight before publishing such information. A simple phone call to the local number for Ecraf Technology is answered by a message advertising their acrobatic prowess. Please be more careful the next time you provide free publicity for such scoundrels!  
ARI VIDERCI  
via e-mail

I just picked up the April issue and read the article about Ecraf Technology’s analog processor. BRDs? Nice April Fools’ joke. You had me going for a moment, because the first time I skimmed it and missed the part about a chip lighting a city with a battery power source. Where can I get one of these?!?  
BILL PFEIL  
via e-mail

I finally got a chance to sit down tonight and read your April issue. The first thing that caught my eye was “Ken Kemski’s” article on the EC909-12. “Wow!,” I said to my wife, “They’ve finally done it—an analog processor that



beats out the digital stuff." She laughed, knowing full well my passion for analog and my distaste for anything digital.

I must admit you really had me going for the first half of the article—then the "light" slowly dawned on me: I never heard of the Ecraf Technology Corp. (ETC) or the Barrier Reflex Diode, and I'm always up on new analog devices. Then I saw it: perfect conductor and insulator at ambient temps; wads of "white light" at less than 1 milliamp. Indeed! Okay, you got me: Ecraf = farce. Great article!

SKIP CAMPISI

S. Bound Brook, NJ

What a great gag!!! I'm not a regular reader of **Electronics Now**, but I managed to catch that "review" of the Ecraf EC909-12 and was totally blown away. I went around for days telling all my friends about it. I'm usually not one to fall for something like that, but it was done so well I couldn't help myself.

Congratulations on a great gag. This one article has done more to make me interested in your magazine than anything else could. Keep up the good work!

VAN WILSON

via e-mail

I read your April Fools' article on the EC909-12 microprocessor, as I have read other April Fools' articles year after year. I dislike them as I have no interest in humor. I have no sense of humor. I want to read fact.

NAME WITHHELD

via e-mail

Great article by Ken Kemski in the April issue of **Electronics Now** about the Barrier Reflex Diode. I've heard there is some very sensitive research being done in some very high areas of our government where the "birds" are being integrated with the "Flux Capacitor" in circuits where the first step in time travel has been solved. They have been able to slow down the speed of light. I'll keep my eyes-n-ears open for further developments.

DALE APPLETON

via e-mail

I am glad to see that the "U.S. Less" company is still in business. I first encountered this company in April 1975 when I tried to locate a "Steam Bucket" used by the US Navy. I later encountered them in

the food service industry with their famous "Jell-O Stretcher" (April, 1980?). Please inform me when the "DVD Rewinder" will be available at my local Wal-mart. I want to be first in line.

J. KNIGHT

via e-mail

## Mr. Möbius Revisited and Mr. Klein Wanted

In my article, "Möbius Circuit" (**Electronics Now**, November 1998), I discovered a mistake: a fundamental error in my description of the Möbius Strip characteristics. I realized this before the article was published, but as this didn't affect circuit performance, I decided to let it stand and see if people were reading and trying out these circuits—was I really reaching you all out there?

As it turns out, I seem to be doing my job! Several people have already caught the error (see "Letters," **Electronics Now**, January 1999)—cutting the Möbius Strip results in TWO intertwined hoops, not ONE larger hoop as stated. Many thanks to all who responded, renewing my faith in our readers. Now, if you want to see something really strange, try cutting the two intertwined Möbius Strips down *their* centers....

On another note, if anyone out there knows where I can purchase a "Klein Bottle," I'd be very interested in hearing about it. Thanks.

EN

SKIP CAMPISI

## THE COLLECTED WORKS OF MOHAMMED ULLYES FIPS

#166—By Hugo Gernsback.

Here is a collection of 21 April Fools Articles, reprinted from the pages of the magazines they appeared in, as a 74-page, 8½ × 11-inch book. The stories were written between 1933 and 1964. Some of the devices actually exist today.

Others are just around the corner. All are fun and almost possible. Stories include the Cordless Radio Iron, The Visi-Talkie, Electronic Razor, 30-Day LP Record, Teleyeglasses and even Electronic Brain Servicing. Get your copy today. Ask for book #166 and include \$9.99 (includes shipping and handling) in the US (First Class), Canada and Overseas (surface mail), and order from CLAGGK Inc., P.O. Box 4099, Farmingdale, NY 11735-0793. Payment in US funds by US bank check or International Money Order. Allow 6-8 weeks for delivery.

MA05



## TIPS FOR MAIL ORDER PURCHASE

It is impossible for us to verify the claims of advertisers, including but not limited to product availability, credibility, reliability and existence of warranties. The following information is provided as a service for your protection. It is not intended to constitute legal advice and readers are advised to obtain independent advice on how to best protect their own interests based upon their individual circumstances and jurisdictions.

1. **Confirm price and merchandise information** with the seller, including brand, model, color or finish, accessories and rebates included in the price.

2. **Understand the seller's return and/or refund policy**, including the allowable return period, who pays the postage for returned merchandise and whether there is any "restocking" or "return" charge.

3. **Understand the product's warranty.** Is there a manufacturer's warranty, and if so, is it for a U.S. or foreign manufacturer? Note that many manufacturers assert that, even if the product comes with a U.S. manufacturer's warranty, if you purchase from an unauthorized dealer, you are not covered by the manufacturer's warranty. If in doubt, contact the manufacturer directly. In addition to, or instead of the manufacturer's warranty, the seller may offer its own warranty. In either case, what is covered by warranty, how long is the warranty period, where will the product be serviced, is there a charge for service, what do you have to do to obtain service and will the product be repaired or replaced? You may want to receive a copy of the written warranty before placing your order.

4. **Keep a copy of all transactions**, including but not limited to cancelled check, receipt and correspondence. For phone orders, make a note of the order including merchandise ordered, price, order date, expected delivery date and salesperson's name.

5. **If the merchandise is not shipped within the promised time**, or if no time was promised, within 30 days of receipt of the order, you generally have the right to cancel the order and get a refund.

6. **Merchandise substitution** without your express prior consent is generally not allowed.

7. **If you have a problem with your order or the merchandise**, write a letter to the seller with all the pertinent information and keep a copy.

8. **If you are unable to obtain satisfaction from the seller**, contact the consumer protection agency in the seller's state and your local Post Office.

If, after following the guidelines, you experience a problem with a mail order advertiser that you are unable to resolve, please let us know. Write to Advertising Department, Gernsback Publications Inc., 500B Bi-County Blvd. Farmingdale, NY 11735.

Be sure to include copies of all correspondence.





# EQUIPMENT REPORT

CANON POWERSHOT A5 CAMERA AND CD-200 DIGITAL PRINTER

*Slip into digital photography  
now with Canon's  
PowerShot A5 digital camera  
and print beautiful still images  
with the CD-200 printer.*



Throughout the early and middle-ages of traditional silver-based photography, getting reprints was as simple a matter as getting the original prints. Generally there was some sort of negative that, if saved, could be used to make new prints at any time—even more than a hundred years later in the case of plate-glass negatives.

More recently, digital cameras have been gaining popularity, and today's better consumer digital cameras, such as Canon's PowerShot A5, provide high-resolution "digital negatives." And Canon's companion CD-200 digital printer makes the best of those images, producing beautiful album-sized color prints from digital images, as well as from any composite or S-Video source.

## Canon PowerShot A5 Camera

The PowerShot A5 has a durable metal alloy body and sleek design. It's small enough to fit in a shirt pocket, yet takes sharp, high-resolution images and has a built-in flash. Its 810,000 pixel CCD allows for a maximum resolution of  $1024 \times 768$  in 24-bit color. The camera also has a  $512 \times 384$  pixel mode that allows you to squeeze more images into memory. It even has an automatic lens cover that flips shut when the camera is turned off. The camera is 4 inches wide by 2.7 inches high by 1.3 inches deep and weighs only 8.1 ounces without batteries loaded.

Images are stored on an 8MB industry-standard CompactFlash memory card,

one of which is included with the camera. The card can be removed from the camera for connectivity with other computer hardware or to be swapped with additional memory cards like rolls of film. The PowerShot A5 has two JPEG compression levels, fine and normal, for both  $1024 \times 768$  and  $512 \times 384$  modes.

Depending on the resolution selected, and hence the image size, the included 8MB CompactFlash card will hold from 44 to 89 images with low JPEG compression and from 125 to 236 images with high JPEG compression. Pictures taken at  $1024 \times 768$  create file sizes of 85KB or 180KB, while  $512 \times 384$  images are either 30KB or 60KB in size. There's also a CCD-raw mode that stores images with no compression, but only 8 of the 940 KB images will fit in memory. Of course you can always buy higher capacity cards. The camera lets you shoot up to 15 frames at one frame per second in  $512 \times 384$  resolution.

The PowerShot A5 has a low-distortion  $f/2.5$  all-glass lens with a 35mm focal length when compared to a 35mm camera. The TTL autofocus works from 3.5 inches to infinity with a special mode for macro shots. Shutter speeds range from  $1/6$  to  $1/750$  of a second. The built-in flash has a range from 8 inches to 11.5 feet and it has four modes: on, off, auto, and red-eye reduction. Exposure compensation can be used for backlit subjects. A full-auto mode sets focus, flash, exposure, and white-balance

settings for you. A program mode allows for greater exposure control.

You can compose images using the built-in 2-inch TFT LCD monitor or with the optical viewfinder to save battery power. Of course you have to use the monitor to view stored images. Images are transferred out of the camera via its serial interface, directly from the CompactFlash card, or via a composite-video output. The video output allows image viewing on a TV or recording on videotape. Serial and video output cables are included.

The camera comes with a rechargeable NiMH battery pack, which is good because digital cameras tend to eat batteries. It also comes with an AC adapter to conserve battery power when an electrical outlet is nearby.

All the software you need is included with the A5. It comes with a Photoshop plug-in for Power Mac and a TWAIN driver for Windows 95/98 and NT. The TWAIN driver allows any TWAIN-compatible application to extract images from the camera via the serial port. Bundled applications such as Adobe PhotoDeluxe 2.0 and Ulead PhotoImpact 4.0 let you adjust color balance, contrast, sharpness, image size, and so on. Canon's PhotoStitch application takes advantage of the A5's stitch assist mode to let you merge images into horizontal or vertical panoramas or in  $2 \times 2$  matrixes. Canon's PowerShot A5 has a suggested retail price of \$420; as usual, street prices are usually lower.

## Canon CD-200 Printer

Canon's CD-200 digital printer is an extremely versatile, yet affordable piece of gear that makes high-quality album-sized color prints. It is the perfect accompaniment to the PowerShot A5 digital camera. The CD-200 accepts digital images directly from a CompactFlash card and makes  $4 \times 6$ -inch glossy photo prints without connecting to a PC—it has a video output to view images on a TV. The memory cards pop into a slot on the printer. The CD-200 is also Windows



and Macintosh compatible with its Centronics and RS-422 connectors. What's really neat about the CD-200 is that a video input lets you capture and print still images from TV programs, camcorders, and other video sources.

The CD-200 is a dye sublimation printer with a resolution of up to 288 dots-per-inch with 256-step gradation. Prints are 4 x 6 inches with an image area of 3.2 x 4.2 inches. It takes about 95 seconds to print an image. Image quality can rival that of 35mm prints depending on the quality of the source image. The CD-200 is only 9.8 inches wide by 10.2 inches deep by 3.3 inches high and weighs only 5 pounds.

JPEG images stored on CompactFlash cards are displayed on a TV as thumbnails. You can select individual images for previewing at full-screen resolution before printing them. Not having to connect the camera to the printer lets you continue to use the camera while printing images as long as you have another memory card.

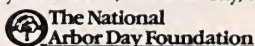
The CD-200 costs \$409. Refills for the CD-200 containing a new print ribbon and 50 sheets of glossy photo paper cost about \$30. That puts the price of prints at 60 cents each, which is cheaper than Polaroid images, and the CD-200's print quality is better. Adhesive-backed sticker media is also available.

The PowerShot A5 is a high-quality digital camera that comes in a small package. It's perfect for creating web content and saving memories in digital form. And the CD-200 digital photo printer gives you hard copy for the photo album. With them you have a complete digital-photography solution that solves all of your home-video/digital-still-camera printing needs at the same time. You'll never have to wait 60 minutes for conventional photography ever again, and reprints are just 95 seconds away.

For more information on the Canon A5 digital camera and/or the CD-200 digital printer, contact the manufacturer directly (Canon Computer Systems, Inc., 2995 Redhill Avenue, Costa Mesa, CA 92626; Tel: 800-385-2155; Web: [www.ccsi.canon.com](http://www.ccsi.canon.com)).

## Trees Make a World of Difference™

Find out how trees can make a world of difference for you, and your neighborhood. For your free brochure write: Trees For America, The National Arbor Day Foundation, Nebraska City, NE 68410.



# Electronics CD ROMs

## Want to improve your design skills?

Then you should consider our range of CD ROMs by best-selling author Mike Tooley.

**Electronic Circuits and Components** provides a sound introduction to the principles and applications of the most common types of electronic components and how they are used to form complete circuits. Sections on the disc include: fundamental electronic theory, active components, passive components, analog circuits and digital circuits. Includes circuit s and assignments for Electronics Workbench.

**The Parts Gallery** has been designed to overcome the problem of component and symbol recognition. The CD ROM will help students recognize common electronic components and their corresponding symbols in circuit diagrams. Quizzes are included. The Parts Gallery is free with Electronic Circuits and Components.

**Digital Electronics** details the principles and practice of digital electronics, including logic gates, combinational and sequential logic circuits, clocks, counters, shift registers, and displays. The CD ROM also provides an introduction to microprocessor-based systems. Includes circuit s and assignments for Electronics Workbench.

**Analog Electronics** is a complete learning resource for this most difficult subject. The CD ROM includes the usual wealth of virtual laboratories as well as an electronic circuit simulator with over 50 pre-designed analog circuits, which gives you the ultimate learning tool. The CD ROM provides comprehensive coverage of analog fundamentals, transistor circuit design, op-amps, filters, oscillators, and other analog systems.

"...hammers home the concepts in a way that no textbook ever could."

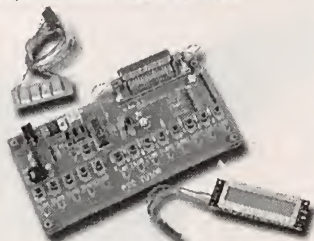
Electronics Australia

## Interested in programming PIC micros?

We have the perfect solution:

Our PICtutor CD ROM can teach you how to write assembly language programs for the PIC series of microcontrollers. The CD ROM's 39 tutorial sections will guide you from basic PIC architecture, commands, and programming techniques up to advanced concepts such as watchdog timers, interrupts, sleep modes, and EEPROM data memory use. Over 80 exercises and challenges are provided to test your understanding, and the unique Virtual PIC allows you to write and test programs on-screen.

The complementary development kit includes a reprogrammable PIC16C84, which you can program via your printer port. The institution version (designed for use in schools, colleges and industry) includes a quad 7-segment LED display and alphanumeric LCD display. The development kit provides an excellent platform for both learning PIC programming and for further project/development work. Assembler and send (via printer port) software is included on the CD ROM.



development board (institution version)

## Prices and Versions

Institution versions are suitable for use in schools, colleges and industry. Student versions are for student/home use.

	student version	institution version
Electronic Circuits & Components	\$56	\$159
Digital Electronics	\$75	\$189
Analog Electronics	\$75	\$189
PICtutor (CD and development board)	\$179	\$350

Shipping costs to Canada an additional \$5. Overseas orders please contact CLAGG Inc. for shipping costs.

see <http://www.MatrixMultimedia.co.uk> for full specs and demos

Please circle the products you would like to buy on the table above right, calculate the total cost, fill in the form below and send it to us. Please allow 4 - 6 weeks for delivery.

Name: \_\_\_\_\_

Address: \_\_\_\_\_

Zip: \_\_\_\_\_ Telephone: \_\_\_\_\_

I have enclosed my check for \$: \_\_\_\_\_

Please charge my credit card for \$: \_\_\_\_\_

Note that the delivery address and the address at which the card is registered must be the same.

Card type: \_\_\_\_\_

Mastercard, Visa, or Discover only

Signature: \_\_\_\_\_

Number: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Expire date: \_\_\_\_\_

CL02

## Order Form



Clagg Inc., PO Box 4099, Farmingdale, NY 11735-0792

Tel: 516-293-3751

email [claggk@poptronix.com](mailto:claggk@poptronix.com)



# Lightning-Fast Online Access

**I**'VE YET TO FIND A COMPUTER USER WHO IS COMPLETELY HAPPY WITH HIS OR HER MODEM. EVEN UNDER IDEAL CONDITIONS, ANALOG MODEMS ALLOW DOWNLOADS AT 53 Kbps—NOT ALL THAT THRILLING.

Considering how cluttered modern Web pages are becoming and how large files of all types are growing, an analog phone line and modem just don't make for satisfactory online conditions.

So how else can you get on the fast lane of the Information Traffic-Congested County Road? (It's anything but a "superhighway" most days.) Just a couple of years ago the only options a home computer user had were modems and ISDN. The former are cheap and slow, the latter is a little faster (64 or 128 kbps, depending on whether you use one or two channels), but hopelessly expensive.

Are we forever doomed to seeing File Download dialogue boxes with messages like "3 hours 45 minutes remaining" in them?

Have no fear. Now there are much faster ways to get data in and out of your computer, without spending a grand a month on a leased pipe to the Net (this is no joke—some companies pay even more). While the high-speed-access technologies we're about to examine are not available in all areas, they will eventually have versions available in every part of the country.

For the time being, many of the solutions we're about to look at are provided by regional providers, instead of nationwide ISPs. That means that except for our first entry I can't really recommend a good company to check out in your area. I apologize in advance for any New

York-area price examples I might use in these pages. They're only included to give an idea of the types of service you might be able to find now or soon in your area.

## Almost Wireless, Almost Usable Anywhere

A nationwide provider offers the first technology we'll examine. It's a decent choice for just about anyone. We're talk-

ing about DirecPC, from Hughes Electronics. Like its brother, DIRECTV, DirecPC uses an 18-inch satellite dish that you'll have to install on your roof (this excludes many renters, obviously). While it's not as peppy as some of the choices we'll deal with later on, it can be installed in almost any town, making it attractive to those living in more rural areas.

How fast is DirecPC? Compared to a modem, plenty fast. Downloads using DirecPC achieve nice 400-kbps speeds, more than three times peppier than ISDN at its best. However, DirecPC can only be used for downloads—don't go yanking that modem out of your PC just yet (though you will need an extra open PCI slot for the dish's interface card).



NO MATTER WHERE YOU LIVE in the country, a DirecPC dish can get you much-faster-than-modem downloads from the Net. While you'll still need a phone line for upstream data, files will come to your PC at 400 kbps.



As you likely know, surfing the Web is bi-directional. Sending e-mail, typing in URLs, clicking links—all these require a way for your PC to send data, too. To accomplish those tasks, you'll need a standard modem and phone line. For most users, though, this isn't a problem; you all just want a faster way to get things into your computer. However, those of you who do a lot of file uploading...

We started our roundup with DirecPC, because it's available everywhere. Yet while it is cheaper than ISDN, DirecPC is still not affordable for everyone. In addition to your phone-line charges, keep the following in mind: You need to buy and install a dish, which could cost anywhere from \$300 (if you install it yourself) to about \$500 (if you don't lift a finger after you place the order).

Then comes the monthly fee. Remember how everyone complained about digital satellite TV when it first came out? You know, they'd say lines like "I bought the dish, now I have to pay what?" Those with satellite TV have it better than DirecPC users, though—they don't have time restraints on when they can watch the tube. DirecPC's monthly service costs \$30 for 25 hours of downloads or \$40 for 100 hours (ISP account included), with each additional hour costing \$1.99.

While the preceding prices aren't exactly exorbitant when viewed alone, they do seem high to someone who just paid up to \$500 for a dish and still has to either tie up a phone line or add one. As much of an improvement as DirecPC is to just a modem alone, a cheaper and still faster option is available in many areas.

## Finally, Something Good on Cable

Next time you're flipping through your 70 or so channels of cable TV, unable to find a single thing to watch, remember that the very same coax coming into your home could be connecting you to the rest of the computing world at a whopping 10 Mbps! That's the amount of speed available to most small networks, and is about 188 times faster than what you can get out of a 56-kbps modem, which due to telephone-line restrictions usually tops out at 52 or 53 kbps.

How is this possible? As it turns out, those new lines cable companies have been installing for years to prepare for interactive-television features can carry a lot more than pay-per-view request signals. Downstream data (*i.e.* to your

home) comes from a channel in the 5- to 750-MHz range; upstream data is carried on a channel in the 5- to 42-MHz band. This infrastructure provides for up to 10-Mbps data transfer, and is now in place in most areas—but whether your cable company provides Net access is another matter.

Before we toast to the speeds of cable, it's important to note that the medium's bandwidth is shared by each neighborhood, which means at best you'll probably only connect at a maximum of about 5 or 6 Mbps—which is *only* 100 times faster than your analog modem—and sometimes as slow as 1 Mbps. Still, at these speeds it will appear to you like

your room of choice and actually set up the hardware and software on your computer (usually an additional \$50). However, don't let these initial fees deter you; cable is no more expensive than analog access. Adding a phone line to a house can cost more than twice as much as the install fee of cable. Furthermore, cable has no per-minute charges, and you don't need to pay an ISP any longer.

Besides the speed that will have you downloading 1.5MB files in about 7 seconds, cable has another nice benefit. It's always online, so when you start up your computer, you're connected to the Net. Live demos I've seen have convinced me



THE COMPAQ PRESARIO 5600 line features xDSL-capable modems.

your machine's accessing data off a hard drive or, at the worst, a floppy disk, rather than the Internet. Cable companies are promising to limit the number of subscribers they connect to each sector area of bandwidth, ensuring that your shared access won't end up back in the analog-modem range some day.

In the NY metro area, cable Internet access costs \$35 a month if you agree to have the service for a year (you don't need to pay it all up front, though). Five bucks of that fee is to cover the rental of a cable modem—an external device that connects to your computer via an Ethernet port. You have to have at least a 10BaseT (10-Mbps Ethernet) Network Interface Card (NIC) in your computer. Many cable companies give NICs away as incentives, but they are very affordable (I've seen many in the \$50 range, some for less).

If you order cable Net access, your cable company will add another line to

how amazing the service is. I might be moving soon, but as soon as the boxes are unpacked, cable Internet is one of the first things I'm having installed.

## xDSL—Some Four-Letter Solutions

Another promising technology is also only available in select areas right now. The final versions of this speedy service will go by different names, but the core system is called xDSL, with the "x" standing for one of several types of Digital Subscriber Lines.

Similar to ISDN—though faster and cheaper—xDSL is a system that requires an area to be equipped with special digital lines. Note that these lines are installed in your area, not just to your home. Once the modifications are made by the phone company, both asynchronous and synchronous forms of xDSL, or ADSL and SDSL, respectively, can

(Continued on page 87)



# Evolution of the AC/DC Set

**W**E BEGAN DISCUSSING SCALED-DOWN-FOR-THE-DEPRESSION "MIDGET" RADIOS IN THE APRIL, 1999 ISSUE OF POPULAR ELECTRONICS. THEN, IN THE MAY ISSUE, WE DROPPED THE SUBJECT TEMPORARILY TO DISCUSS PHILCO'S MUCH LESS

drastic approach to depression downsizing, which led to the development of the very popular (and far from small) "cathedral" radios. Now it's time to return to the original story thread and trace an important line of radio evolution which began with the first "midgets."

## The International Kadette Universal

Back in that April column, the "International Kadette Universal" (definitely a midget) was presented as what was probably the first of a very influential design that became known as "AC/DC." Let's review the meaning of that term.

The Kadette used only three tubes (excluding rectifier). The reason it could get by with so few was that the tubes (types 39, 36, and 38) were from a newly-introduced (in 1931 and 1932) high-performance series designed for auto radio service. Two of those (the 39 and 38) were of the new "pentode" design that offered greatly enhanced performance with little or no increase in parts count. See the April, 1999 *Popular Electronics* "Antique Radio" column for a schematic of the Kadette.

As part of the strategy for eliminating the large and expensive power transformer, the heaters of the three tubes were made to operate directly from the AC line. This was done by putting the three 6.3-volt heaters in series, like an old-fashioned set of Christmas-tree

lights. In that configuration, they required 18.9 volts to operate. Placed directly across the AC line, the string of tubes would of course immediately burn out. However, a 310-ohm power resistor, mounted under the chassis, was included in the series string to drop the line voltage by about 93 volts more.

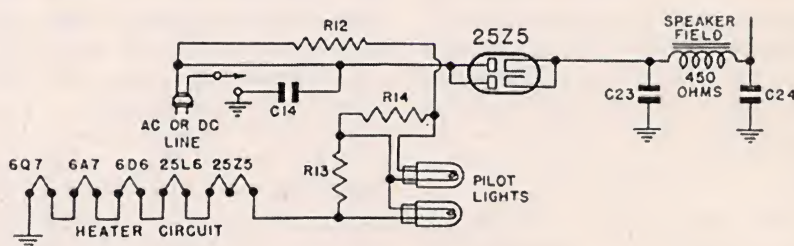
Because there was now no power transformer (a device that could operate only on alternating current), the Kadette could operate from DC as well as the AC line. In those days, the downtown sections of many large cities were still supplied with DC current, which had to be converted to AC by various means to operate common appliances and motors. While this wasn't really a very big market, AC/DC operation was still a useful selling point and radios with series string heaters became known universally as "AC/DC sets."

This system probably wouldn't have even been considered had the auto tubes

with their 6.3-volt, 0.3 amp heaters (designed to operate with minimal drain from the storage batteries of the day) not been available. The 2.5-volt 1.75-amp range of tubes then common in home radios would have required a much heavier series resistor to drop the larger voltage at heavier current. As it was, several watts of power had to be dissipated in the resistor. Power dissipation means heat dissipation, and things get hot enough under the chassis to shorten the life of capacitors and other components.

## Cooling-Down Strategies

The heat problem was minimized through innovations on several different fronts. First, the "below decks" power resistor was very soon replaced by one of two devices: (1) the "ballast resistor," which looked like a metal tube (sometimes with heat-releasing perforations in its metal shell), plugged in atop the chassis like any other tube or (2) the line-cord resistor, which was an extra conductor—made of resistance wire—built into the line cord. In both cases, the heat generated by the resistance element was prevented from overheating the space beneath the chassis. However, it's not unusual to find ballast sets with cabinets discolored (or even charred) by heat



A TYPICAL AC/DC power-supply circuit. The heaters of the five tubes are in series; R12 is a ballast resistor; pilot lights operate from a separate tapped resistor. The speaker field coil doubles as filter choke.



generated above the "tube."

The line cord resistor has often confused new hobbyists who may replace it, when frayed, with an ordinary two-wire cord. The result is a dead radio and (depending on which two of the three connection points in the set is used for the new cord) possibly a set of tubes with blown heaters. In attempting to replace the plug on such a cord, neophytes may also either ignore the fine and easily broken resistance wire or tie it to the wrong side of the line. In either case, though no damage will be done, the tubes will not light.

Cords with line cord resistors can be recognized by their fatter-than-usual cross section and (usually) cloth outer covering. Often this covering is frayed in places, exposing the asbestos insulation underneath. If a frayed cord is in working order, don't be tempted to replace it. Resistor cords are hard to come by—though there are alternatives that can be discussed in future articles.

### Tube Evolution in AC/DC Sets

Another innovation was the introduction of tubes with higher heater voltages. The first ones to appear were audio-output tubes such as the 25L6 and rectifiers such as the 25Z5. Tubes in those categories, because of the greater power that they handle, could especially benefit from the greater heater output made possible by the higher operating voltages.

It's not uncommon to find early AC/DC sets with a 25-volt rectifier tube and three 6-volt tubes or with 25-volt rectifier and audio-output tubes and two 6-volt tubes. In either case, significantly less power needed to be dissipated in the ballast or line-cord resistor to drop the remaining voltage.

Among the six-volt tubes providing the detector, RF-amplifier, and AF-amplifier functions in sets with line-cord or ballast resistors and two 25-volt tubes as described are the types 39 and 36, the later types 78 and 77, or the still later 6C6, 6D6 and 6Q7. Six-volt power output tubes in sets not equipped with a 25-volt version are typically type 38 or the later type 43. When five-tube superheterodyne circuits began to replace the four-tube tuned radio-frequency designs, the 6A7 pentagrid converter (also six-volts) began to appear.

As the five-tube superhet circuit became standard in the late 1930s, a whole new series of tubes, all with high-voltage heaters for series heater-string

operation, emerged. One configuration was so commonly used that it became known as the "All-American Five." That set was made up of a 12SA7 pentagrid converter, 12SK7 RF/IF amplifier, 12SQ7 detector/amplifier, 35L6 power output, and 35Z5 rectifier. Note that the heater voltages (first two digits of the type number) add up to 106, which was close enough to the nominal 115-volt line voltage so that no ballast or line-cord resistor was needed.

### Other AC/DC Design Features

As has been mentioned in some of the earlier articles on this subject, other changes were also made in the power-supply circuitry in order to reduce size, weight, and cost. Among the earliest simplifications was to substitute the field coil of the dynamic speaker then in common use for the power-supply filter choke. The coil substituted for the choke while at the same time receiving the energizing voltage required for the speaker to operate.

Still later, the development of efficient permanent-magnet speakers rendered dynamic speakers obsolete and field windings disappeared. By that time, however, inexpensive high-capacity electrolytic filter capacitors were available. Using them, filtering action became so much more efficient that a power resistor of a few hundred ohms could be substituted for the choke.

By now, improved tubes and circuitry had made sets so sensitive that the traditional hank of antenna wire, unrolled under a rug or tossed out the window, became unnecessary. A neat, self-contained loop antenna, usually mounted inside the back of the cabinet, was enough to do the trick.

Changes in cabinet design also rate at least a brief mention. The original midget sets were housed in compact wooden cabinets. Made to sell as cheaply as possible while yielding a profit for the manufacturer and dealer, very little thought or money was expended on the radio's looks. Nevertheless, many of these wood cabinets had a kind of naive charm that I, personally, enjoy.

By the early 1940s, more and more cabinets were being made of plastic. This material (usually Bakelite either left in its natural brown color or with a painted finish applied) was easy both to mass produce and to mold into the "streamlined" rounded shapes favored during that era. Also, the newer genera-

tion of tubes were about half as high as the types used in the original AC/DC sets, allowing for the cabinet to have a lower, sleeker profile. More attention began to be paid to the aesthetics of the cabinet, and the inexpensive sets began to have a more sophisticated look.

Catalin plastics, which could be produced in a variety of glowing colors, were also sometimes used. Catalin cabinets are fragile and become more so with age, often cracking spontaneously because of internal stresses in the material. Catalin cabinets are rare, especially in flawless condition. They are much



BY THE 1940s, inexpensive plastic-molding techniques were making it possible to mass produce cabinets with a sleeker, more sophisticated look.

prized by some collectors today and a Catalin radio that sold for \$19.50 in 1940 might well change hands at \$1000 today!

### Military Radio Collectors Take Note!

I recently received a query from Major (Ret.) Richard J. Blondis, 291 East Calle Herboso, Green Valley, AZ 85614; Tel: 520-393-0922. The Major has a World War II German military shortwave radio gathering dust in his storage area. He'd like help valuing the set and figuring out how to market it. The markings on the set are: *Telegrafien Werkstatte, Musterr RV 14, Serie II Number 151*. Contact Major Blondis directly if you can assist him or if you are personally interested in the radio.

That's it for this month! We'll see you in July. In the meantime, send your comments and suggestions to me at "Antique Radio", c/o Electronics Now, 500 Bi-County Blvd., Farmingdale, NY 11735-3931. Or use my personal e-mail address: [ellis@interaccess.com](mailto:ellis@interaccess.com). Regrettably time limitations do not always permit me to respond individually. But all correspondence will be read with interest and acknowledged in the column.



# NEW PRODUCTS

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

## Oscilloscope Software

GAGESCOPE FOR WINDOWS IS oscilloscope emulation software for controlling the CompuScope family of PC-based oscilloscope and data-acquisition cards. It supports up to 32-channel oscilloscope systems and gives the user complete control of the CompuScope card. The stand-alone software includes waveform cursors, multiple windows with different timebases, the ability to save and load signals, compatibility with SIG files used with the CompuGen arbitrary waveform generator, and more.

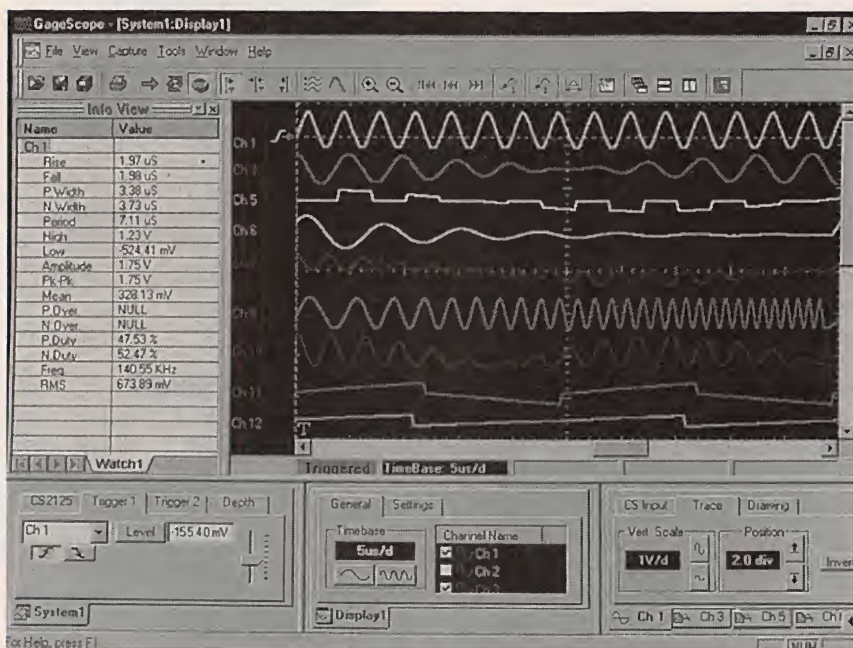
more. Settings are located in convenient on-screen controls. All settings are separated into three different controls—System, Display, and Channel—depending on their function.

In combination with a CompuScope data-acquisition card, GageScope for Windows can be used for applications such as disk-drive testing, cellular communications, RF receivers, radar, lidar, imaging, non-destructive testing, ultrasonic testing, laser Doppler anemometry, high-end video, CCD testing, vibration

LCR meter that measures resistors, inductors, and capacitors at 20X per second rate, with 0.5% accuracy, simplifying automated testing and sorting. Component "Q" values and dissipation factors are also displayed via front-panel LCD readouts. For remote operation, the instrument is equipped with RS-232, GPIB, and Handler Port Interfaces. The



CIRCLE 21 ON FREE INFORMATION CARD



CIRCLE 20 ON FREE INFORMATION CARD

GageScope for Windows is a powerful and easy-to-use FFT package. Not only can it do multiple channel spectral analysis, it allows for simultaneous viewing of time and frequency domain data. The software features the ability to change most settings with the click of the mouse.

Available settings include sample rate, channel mode, pre- and post-trigger depth, trigger level, trigger slope, timeout, multiple record, timebase, channel visibility, input range, input coupling, vertical scaling, drawing method, polarization, interpolation, and

analysis, laser diode characterization, and impact testing. GageScope for Windows has a suggested retail price of \$495.

**GAGE APPLIED SCIENCES INC.**

1233 Shelburne Road, Suite 400

S. Burlington, VT 05043

Tel: 800-567-GAGE or 514-633-0770

Fax: 800-780-8411 or 514-633-7447

Web: [www.gage-applied.com](http://www.gage-applied.com)

## LCR Meter

EASY TO USE AND CALIBRATE, the Protek Z9216 is an advanced design

unit accepts optional SMD tweezers, BNC fixture adapters, and Kelvin Clips.

It stores and recalls nine instrument setups and has five test frequencies from 100 Hz to 100 kHz and measurement averaging from 2 to 10. Other important features include open- and short-circuit compensation, accurate zeroing, built-in calibration procedures, and binding capabilities. Compact in size, it measures approximately 4 by 14 by 14 inches and weighs almost 13 pounds. The Z9216 sells for \$1750.

**HC PROTEK**

154 Veterans Drive

Northvale, NJ 07647

Tel: 201-767-7242

Fax: 201-767-7343

e-mail: [hcprotek@aol.com](mailto:hcprotek@aol.com)

Web: [www.bcprotek.com](http://www.bcprotek.com)

## Robotic Video Camera Controller

A NETWORKABLE ROBOTIC video camera controller, the Transit RCM (Robotic Camera Mount) is a computerized positioning control for network video cameras. It adds intelli-

(Continued on page 84)



# Phototype

## Counting The Particles On The Head Of A Pin

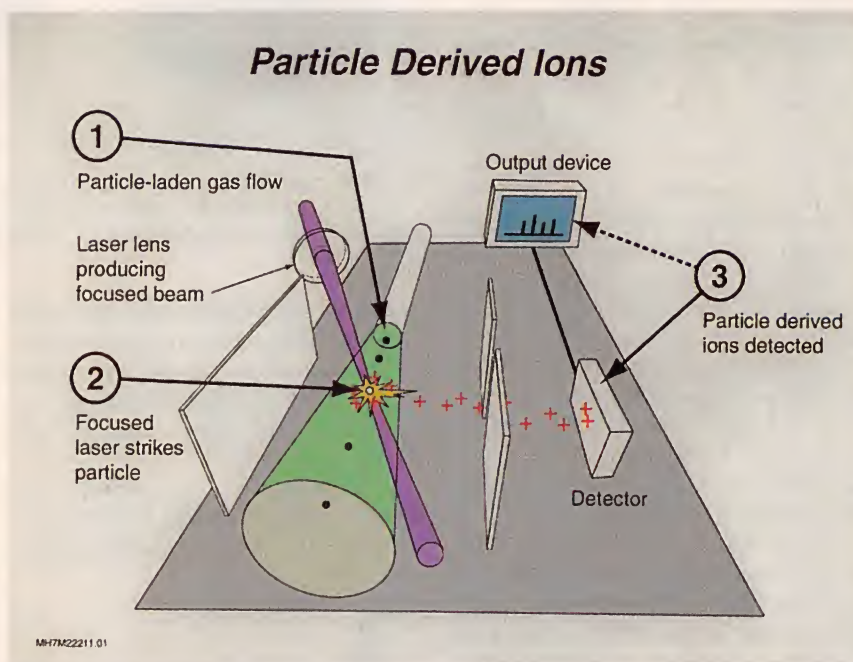
**T**he bar has been lowered in particle-detection technology. A chemist at Bell Labs, William Reents, has designed a novel instrument that detects particles 100,000 times smaller than a pin head, or about one-thousandth of a micron—a development that could have a major impact on semiconductor manufacturing.

Today's transistors, for instance, are roughly one-quarter of a micron wide and as thin as one-hundredth of a micron. As a result, they are subject to short-circuiting by minuscule particles that escape detection during manufacture.

Current particle-detection techniques, which involve spot-checking the surfaces of silicon wafers by observing whether light is reflected by particle deposits, detect particles only as small as two-tenths of a micron. This method requires the entire manufacturing process to be halted for inspection, and it is unable to determine size or composition of the particles found.

The new instrument, whose capability has been demonstrated only in Reents' laboratory, detects particles between one-thousandth of a micron and nine-tenths of a micron (the average dust particle is 50 microns) during the process of semiconductor manufacturing and analyzes the particles in a gaseous phase. While transmission electron microscopes can see much smaller particles (as small as an atom, or one ten-thousandth of a micron), those instruments can only analyze particles stationary on a surface.

The Bell Labs instrument pulls gas particles out of the vacuum chamber individually, detecting up to 10 particles per second. "What we do is, we pull a little bit of the gas stream with particles from the chamber and bring them into our 'particle blaster,'" said Reents. A high-intensity pulse laser hits each par-



BELL LABS' PARTICLE DETECTOR extracts gas particles out of the vacuum chamber individually, detecting up to 10 particles per second. A laser strikes each particle, shattering it into charged atoms and molecules, which accelerate at various velocities toward a detector. Based on the weights and charges recorded, the instrument instantaneously determines the particle's quantity, composition, and size.

ticle, breaking it up into charged ions and molecules. These then accelerate at various velocities, depending on their weight, and strike a detector. Based on the weights and velocities recorded, the instrument determines the particle's composition and size.

This ability to analyze particle composition is also of interest in circles outside semiconductor manufacturing. Reents is at work adapting the instrument to detect and analyze ambient particles in the surrounding atmosphere. While other sensor methods can detect particles as small as a micron, they cannot determine the complete composition of those particles. Atmospheric

analysis, Reents said, has become increasingly important in recent years as government regulators have voiced concern about the health effects of sub-micron-sized airborne pollutants, both indoors and out. Another possible application for the detector is in performing trace analysis of particles in ultra-pure liquids, which are commonly used in pharmaceuticals and semiconductor manufacturing.

Still, the Bell Labs device, which has the ability to detect particles in real time in a vacuum chamber, will likely find its first application in semiconductor manufacturing. Better particle detection is important because transistors will



approach the one-tenth-of-a-micron range in the near future. The ability to detect smaller and smaller particles will become even more important because tiny particles will be able to sneak into the increasingly smaller transistor features.

In semiconductor processing, the current particle detection practice is to put a monitor wafer in the semiconductor production chamber, let it sit there for some period of time, pull it out and count particles on it. "You're limited to doing this only when you are not processing, so it doesn't reflect the conditions of the chamber during normal processing," Reents said. "Our instrument, on the other hand, can see particles whether you are processing or not processing, without affecting the process at all. You can have the plasma running, you can be doing chemical vapor deposition, and it should work for any of those cases."

Reents believes the instrument, the research for which has been internally funded by Lucent, should be able to detect just about any particle. "We've tried it on a dozen different things," he said. "We tried it on some really tough ones. Silica, for example, is easy to see with this instrument; some people have trouble detecting silica particles."

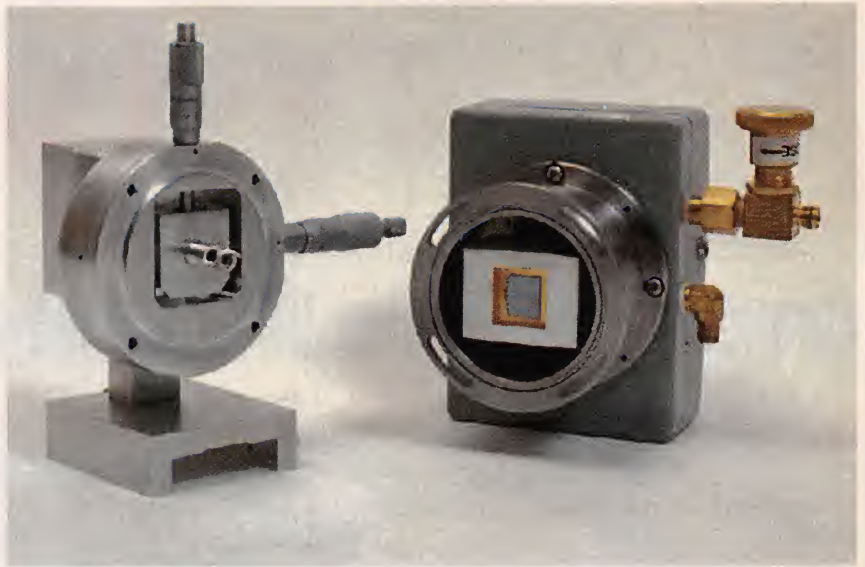
More testing is planned before Reents confirms the device's suspected potential. "We are testing it on some instruments in our clean room, with some success so far," he said. "What we need to do is test it on several instruments, show that it's broadly applicable and how good it is—quantify its signal relative to that of a monitor wafer, because when you have one tool that the engineers rely on you have to be benchmarked against that. If you can't duplicate what they're used to, you've got problems. So we're benchmarking now."

After that, Reents hopes to license the technology and make a commercial instrument available. "I think there should be a lot of interest," he said.—by Douglas Page

PT

## If Rocks Could Talk

**T**he origins and histories of planetary, asteroidal, and cometary bodies are reflected in their building materials. Less than 100 naturally occurring elements combine together to form over 3800 known minerals. This tremendous



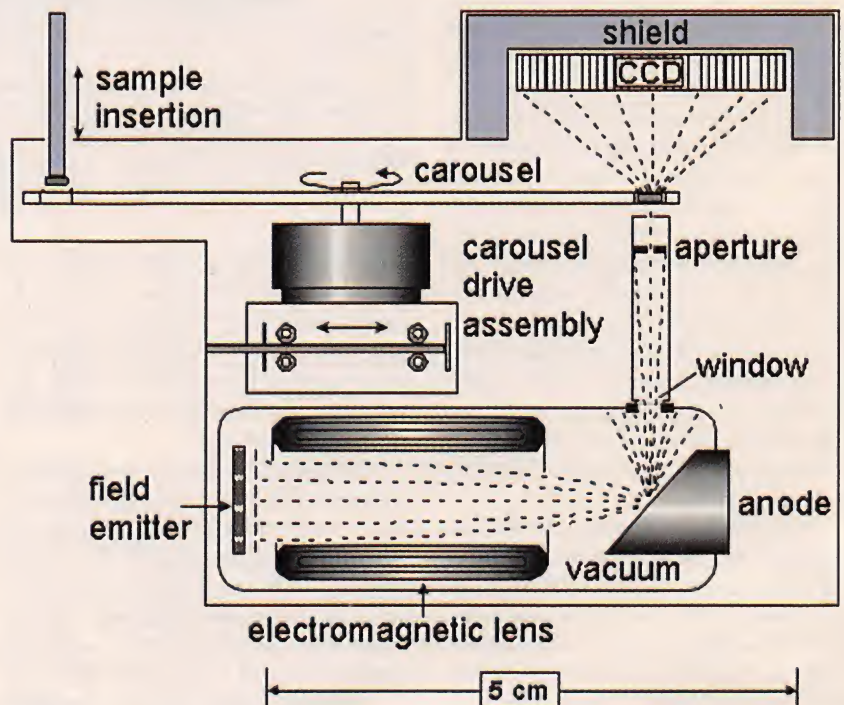
CHEMIN (for CHEmistry and MINeralogy) is a miniaturized XRD/XRF instrument that uses a tiny X-ray tube and a charged-coupled device (CCD) to remotely analyze fine-grained soils, rock, and even ice samples, for chemical and mineralogical information.

variety of mineralogy carries stories of pressure, temperature, oxygen fugacity, and solution chemistry—all intertwined with histories of sedimentation, igneous activity, metamorphism, impacts, and surface weathering.

Simultaneously determining the chemistry and mineralogy of these bodies reveals the history of their formation

and evolution. In order to do this type of analysis, both X-ray diffraction (XRD) and chemical analysis by X-ray fluorescence (XRF) of minerals that contain water (including ice), sulfur, or halogens are required.

Recent progress in X-ray detector technology paved the way for the development of simultaneous XRD and XRF



THIS SCHEMATIC DIAGRAM shows the components of the CHEMIN instrument.



analysis. CHEMIN (for CHEmistry and MINeralogy) is a miniaturized XRD/XRF instrument that remotely analyzes fine-grained soils, rock, and even ice samples, for chemical and mineralogical information. Using a tiny X-ray tube and a charged-coupled device (CCD), CHEMIN can answer questions about extraterrestrial mineralogy. It also has applications on Earth in situations where a small, low-powered instrument is needed, such as in geological sampling at remote, dangerous sites, or where soil has been contaminated.

A flight-ready version of CHEMIN is the size of a soda can, weighs less than a kilogram, consumes only a few watts of power, and can be mounted on fixed landers, soft penetrators, or small robotic rovers. Small enough to fit onto a planetary rover, like the recent Martian rover, CHEMIN gathers chemical data and crystalline structure information simultaneously from samples. Knowledge of crystalline structure is essential in determining whether a chunk of extraterrestrial carbon is a diamond or a lump of coal.

The quality of CHEMIN XRD data has now progressed to a point where trace mineral occurrences (<1%) can be identified and quantified. Such applications illustrate the high sensitivity of the prototype CHEMIN instrument, currently in use at NASA Ames Laboratory, in detecting very small quantities of diagnostic minerals. In operation since July 1996, this prototype instrument, the collaborative work of Los Alamos and NASA researchers, has verified the principle of CCD-based simultaneous XRD and XRF. However, the instrument is composed of surrogate components that do not illustrate the full capabilities that can be realized with an optimized instrument.

Nevertheless, the data obtained with the CCD-based instrument are sufficient not only to determine the mineral phases present, but also to apply Rietveld analysis in estimating the relative proportions of mineral phases in the sample. Rietveld analysis involves calculating a model diffraction pattern based on the crystal structures of the known phases in a mixture. The quality of fit between the observed and calculated diffraction patterns is then improved via a least-squares process in which relative

amounts of each phase and crystal structure parameters are varied. In addition, software is being developed to combine both the chemical XRF data and the XRD result to perform this operation more rigorously. **PT**

## They Bend, But They Don't Break

**S**mall enough to weigh viruses and other sub-micron scale particles, a "nanobalance" is one application for newly-discovered electronic and micro-mechanical properties of carbon nanotubes. The use of the tiny tubes in this way depends on the ability to calculate changes in the resonant frequency that occur with placement of an object onto a nanotube.

"This is comparable to putting an object on the end of a spring and oscillating it," said Dr. Walter de Heer, professor in the Georgia Institute of Technology School of Physics. "By knowing the properties of the spring, you can measure the mass of the object. We can use the nanotube like a standard calibrated spring."

Applying this technique, Georgia Tech researchers were able to measure the mass of a 22 femtogram ( $10^{-15}$  grams) graphite particle attached to the end of a resonating nanotube. "There is no other way to weigh accurately something that small," de Heer noted.

They studied the behavior of multi-walled nanotubes using a transmission electron microscope with a unique sample holder designed and built by their colleague Dr. Philippe Poncharal. The holder allowed them to rotate specimens, apply electrical voltage, and observe many fundamental effects. The work was sponsored by the U.S. National Science Foundation and the U.S. Army Research Office.

Electrical voltage can be used to induce electrostatic deflection and vibrational resonance in individual carbon nanotubes. This ability to selectively deflect or induce resonance in individual nanotubes opens new potential micromechanical applications for the tiny structures, which are smaller than the finest features on modern microcircuits.

The researchers applied an oscillating voltage to induce resonant vibration in the nanotubes. Resonant nodes

appear in the tubes just as they would in a vibrating guitar string. Each nanotube resonates at a specific frequency that depends on its length, diameter, density, and elastic properties.

"You can select which one you want to examine and make it resonate," Poncharal explained. "Then you turn up the frequency and another one will resonate." The resonance occurs in a very narrow range, allowing the researchers to measure the damping properties of the nanotubes.

"This opens a broad new field of study," said de Heer. "To show that we can manipulate individual carbon nanotubes while examining them with an electron microscope is breaking new ground."

By applying a charge to a nanotube placed near an oppositely-charged probe, the researchers were able to severely bend the tiny structures. "We can bend a nanotube almost 90 degrees, and it will still recover and straighten out," said Dr. Z. L. Wang, professor in the School of Materials Science and Engineering. "You can keep on bending them and they will not break. This shows that although nanotubes are very rigid, they have an extremely high elastic limit. Very few materials can do this without damage."

As nanotubes are made thicker and thicker, they enter a new mode of bending. Using high-resolution transmission electron microscopy, Dr. Daniel Ugarte of the Laboratorio Nacional de Luz Sincrotron in Brazil observed a rippling on the surface of thick nanotubes as they deflected. This confirms that bending in these tubes is different.

"The elastic constant is varying as a function of its diameter, which is unexpected for a general material. This elastic constant should be an intrinsic property of the tubes, rather than depending on its geometry or size," explained Wang. **PT**

## The Once and Future Fridge

**D**eveloped by Frigidaire Home Products, with technology innovations from ICL's retail systems division, the first online refrigerator recently made its debut. It provides an opportunity for "anything, anytime, anywhere" shopping.



From their kitchens, consumers can access selected retailers, order, scan and purchase goods, pay their bills, and even watch television and send e-mail messages—all from their fridge.

The prototype online refrigerator incorporates a flat-panel touchscreen monitor and bar-code scanner, both located on the door, and has a 233-MHz personal computer installed within the unit. It runs Microsoft Windows 95 using 32 MB of RAM. It also includes an external Ethernet connection.

There are two ways for the refrigerator to be connected to the Net. The refrigerator could be connected to a standard telephone line for dial-up capabilities to an Internet service provider. This requires only that a telephone line, jack, and cable be near the unit. The other method is to connect the refrigerator to an in-home Ethernet network. In that case, an available port on an Ethernet hub is all that's needed to connect the in-refrigerator PC to the hub

via an Ethernet cable.

"Internet shopping is taking off, but until recently, it was mostly the sale of books, CDs, and other leisure or entertainment items," says Tony Evans, spokesman for Frigidaire Home Products. "Also it focused on the PC or Web TV, which are not in the right place for people we call Kitchen Managers. This development can bring 'home shopping' directly into the kitchen and thus into the hands of the Kitchen Manager—the person who is responsible for running the heart of the home and who is responsible for most weekly purchasing decisions. With ICL, we've shown it can be done." **PT**

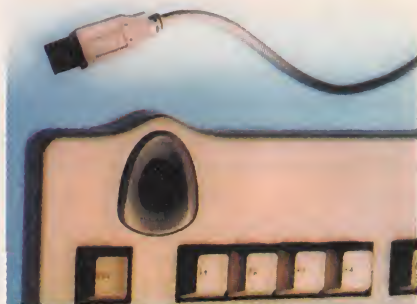
## Your Identity, Please

**D**esigned for Personal Computer and network security, the PFS-100 from Polaroid, a low-cost finger-image scanner, is targeted at users with desktop security concerns and for personal security in e-commerce applications. It will be sold through original equipment manufacturers (OEMs) and integrated into computer systems and keyboards. Key Source International Inc. will be integrating the PFS-100 into their keyboard product line later this year.

The finger scanner is about the size of a pack of gum and can be easily integrated into USB keyboards and other devices in any orientation. The CMOS chip used in the PFS-100 is manufactured for Polaroid by ATMEL Inc. and IBM supplied the advanced finger analysis software.

Philip J. Scarfo, vice president of biometrics for Polaroid, said "We are using the knowledge and experience of more than 50 years in the identification business to create a family of reliable biometrics components that meet

the security needs of our customers. PFS-100 combines the best of optical and CMOS sensor technology to create a very durable and low-cost device. The PFS-100 finger-image scanner is a direct result of our experience with finger images and with large-scale identification programs." Polaroid produces some 300-million identification documents worldwide each year.



THIS FINGERTIP SCANNER gives computers and other devices enhanced security while eliminating the need for passwords, PIN numbers, etc.

The new device is a logical extension of the identification tools and identification technology developed by Polaroid's worldwide ID systems business unit. Polaroid ID card and biometric technology already authenticates identification documents and their owners and protects driver's licenses, passports, and other identification documents from tampering and counterfeiting.

"The PFS-100 finger-image scanner is just one of the devices that will be needed to eliminate PINs and passwords, enhance PC and network security and enable e-commerce," said Robert S. Murray, president of Polaroid's Identification and Transaction Systems division. "Identity theft and fraud are serious and growing problems. Annual reported worldwide fraud losses are reported at more than \$1 billion."

Polaroid has been producing driver's licenses and identification cards using both photographic and digital systems. The company currently produces driver's licenses in 37 U.S. states including California, Texas, Georgia, Hawaii, and West Virginia. Polaroid's Georgia driver's license solution is the largest civil biometric system in place worldwide with more than 5 million drivers carrying licenses protected with fingerprint verification. **PT**



BRINGING THE INTERNET into the kitchen, this refrigerator can even do your shopping for you.





## National Professional Service Convention and Professional Service Trade Show

August 2-7, 1999 • Addison (Dallas) Texas  
Hotel Inter-Continental



**Hands-On Technical Seminars**

*Above: A group of technicians experience one of several hands-on technical workshops (limited seating).*

*Below: Business owners update their business knowledge at a business management seminar.*



**Business Management Seminars**

*Below: A lively Trade Show floor is encountered by visitors and exhibitors alike at the 1998 Professional Service Trade Show.*



*For more information, or to register, contact:*

NESDA, 2708 West Berry St., Fort Worth, Texas 76109  
(817) 921-9061; Fax (817) 921-3741; [www.nesda.com](http://www.nesda.com)

### **Hands-On Technical Seminars:**

- Consumer Product Servicing
- Improve your technical expertise

### **Business Management Seminars:**

- Improve your bottom line
- Increase your business efficiency

### **Professional Certification:**

- Certified Electronics Technicians - Associate or Journeyman options
- Certified Service Manager
- Refresher for CSM prior to testing

### **Instructors' Conference:**

- Review computerized materials
- Hone your teaching skills

### **Service Industry Forums:**

- Electronic Service Literature
- NESDAnet
- Hot industry topics TBA

### **Networking with Major Mfrs.:**

- Service Information Symposiums
- Meet face-to-face with Reps

### **Two Day Trade Show:**

- See the latest products, software
- Business Aids
- Service Equipment

### **Trade Association Advancement:**

- NESDA Elections
- ISCET Elections
- Setting goals

### **Rest and Relaxation:**

- Sponsored Meals
- Golf Outing, Sponsored Tours
- Visit famous Dallas sites



# Testing Flyback Transformers

**W**HEN PROBLEMS DEVELOP IN THE HORIZONTAL DEFLECTION/HIGH VOLTAGE SUBSYSTEMS OF TVs OR MONITORS (OR EVEN MODERN OSCILLOSCOPES AND OTHER CRT DISPLAYS), THE FLYBACK TRANSFORMER (OR LINE-OUTPUT TRANS-

former for those on the other side of the pond) is often a suspected cause. That is due in part to the fact that the flyback is usually the most expensive and hard-to-find replacement part in the unit and because flybacks are often less well understood than other more common components.

This month, we will look at the flyback in detail. We'll deal with what it is, how it fails, how to test it, and what to do if it is indeed defective. But first, a...

**Warning:** Read, understand, and follow the safety recommendations published in previous "Service Clinic" articles or at my Web site ([www.repairfaq.org](http://www.repairfaq.org)) before attempting any troubleshooting of a monitor or TV! If you don't know what you are doing, or are careless, both you and your set could suffer irreparable harm.

## What Is The Flyback?

The typical flyback or Line OutPut Transformer (LOPT) consists of two parts:

- A special transformer that, in conjunction with the horizontal-output transistor/deflection circuits, boosts the B+ of the low-voltage power supply to the 20 to 30 kV for the CRT and provides various secondary lower voltages for other circuits.
- A voltage divider that provides the focus and screen supplies. The focus and screen are generally the top and bottom knobs, respectively.

## Why is the Deflection and High Voltage Combined?

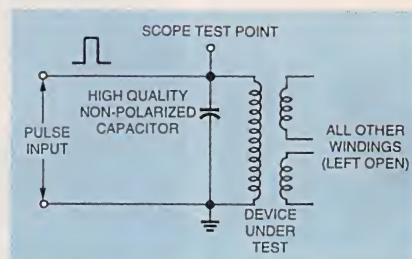
One of the main reasons that TVs and many monitors are designed with horizontal-deflection driven flybacks is simply economics—it provides a cheap way to get the high voltage and many or most of the other voltages for the set with minimal hardware. (High quality computer monitors sometimes use a separate high-voltage supply.) The use of the horizontal frequency rather than the AC-line frequency of 50 or 60 Hz allows the power-supply components to be small and light compared to a line-operated power transformer and filter capacitors.

## Flyback Construction

While details can vary somewhat, all flybacks consist of a set of windings on a gapped ferrite core. High-voltage diodes and resistive dividers (often with adjustment pots) for focus and screen (G2) may also be present.

A typical flyback includes the following components:

- Drive winding—for a typical TV or monitor, this may be 100 or so turns of medium gauge (e.g., AWG 26) wire. This is what is connected in series with the B+ to the horizontal output transistor in a TV or monitor.
- High voltage winding—several thousand turns. This winding may be split into several series sections with a high-voltage rectifier for each, or it



**FIG. 1**—IF YOU HAVE A SCOPE, a ring test using this set up is the easiest way to test a flyback.

could be a single winding. An alternative is to provide a lower-voltage winding and use a voltage multiplier (diode-capacitor ladder) to boost that to what is required by the CRT. Very fine wire (e.g., AWG 40) will be used for the high-voltage winding. The high-voltage lead to the CRT is fed from the highest voltage output of the rectifier or multiplier. (Sometimes the multiplier is external.)

- Resistive divider network for focus and screen (G2)—this will probably be fed from only one of the series connected windings (if used). Often, there are adjustments for focus and screen right on the flyback.

- Auxiliary windings—anywhere from a couple of turns (for the CRT filament) to several hundred turns (for a boost source). Those supply various voltages for the typical TV or monitor: CRT filament, logic power, analog power, boost source (where the flyback does not include its own screen supply), etc.

- Ferrite core—this consists of two C shaped pieces clamped together with either a spring arrangement or studs and nuts. There will be a gap of a fraction of a millimeter provided by a set of spacers between the two C sections.

Most modern flybacks have all the windings on the same leg of the core. The drive winding and auxiliary wind-



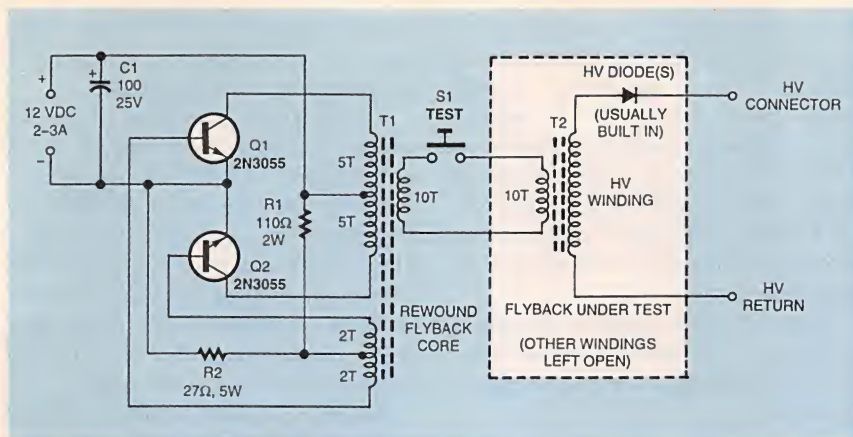


FIG. 2—THE CHOPPER-BASED FLYBACK TESTER excites a flyback in much the same way as would occur in normal operation.

ings will be wound and separately insulated under the high-voltage winding. The high-voltage winding will consist of many layers that have insulating material (i.e., Mylar) between them.

The other components will be mounted in a separate part of the assembly and the entire unit is then potted in an Epoxy-type filler. Part of the core is generally accessible—often one entire leg.

A flyback is not an ordinary transformer. The ferrite core contains a gap. Energy is stored in the magnetic field of the core during scan as the current is ramping up. This was discussed when we dealt with deflection systems in previous Service Clinic articles on deflection systems.

**CAUTION:** The gap is critical to the proper operation and is usually determined by some plastic spacers. Mark each one and replace them in exactly the same position if you disassemble the core for any reason.

## Why Do Flyback Transformers Fail?

While flyback transformers can on occasion be blown due to a failure elsewhere in the TV or monitor's power supply or deflection circuits, in most cases, they simply expire on their own. Why?

Flybacks are wound with many layers of really, really fine wire with really, really thin insulation. This entire assembly is potted with an Epoxy resin that is poured in and allowed to cure.

In some ways, these are just short circuits waiting to happen. Flybacks get hot during use, and this leads to deterioration of the insulation. Any imperfections, nicks, or scratches in the insulation, or

trapped air bubbles and impurities in the Epoxy fill material contribute to failure. Temperature cycles and manufacturing defects result in fine cracks in the Epoxy potting material reducing the insulation breakdown voltage, particularly in the area of the high-voltage windings, rectifiers, and focus/screen divider network. They also physically vibrate to some extent. A whole bunch of other factors are also no doubt important.

Once a breakdown—sparking or arcing—develops, it is usually terminal. Actually, it is amazing that flybacks last as long as they do with the stresses they are under.

## How Do Flyback Transformers Fail?

Flybacks fail in several ways:

1. Overheating leading to cracks in the plastic and external arcing. If there is no major damage to the windings, repair may be possible. However, arcing from the windings punctures their very thin insulation so that shorted windings may already have developed. Even if the windings are currently in good condition, long-term reliability of any such repairs is questionable.

Nonetheless, it doesn't hurt to try cleaning and coating with multiple layers of high voltage sealer, corona dope, or even plastic electrical tape (preferably as a temporary repair, though I have gotten away with leaving this in place permanently). If possible, moving the point to which the flyback is arcing further away (i.e., a piece of metal or another wire) would also help.

2. A cracked or otherwise damaged core will effect the flyback characteristics to the point where it may not work correctly. In some cases that could even blow

the horizontal output transistor and other expensive parts, like the low-voltage regulator or switch-mode power supply. If the core can be reconstructed so that no gaps (other than the required ones where the two halves join) are present and clamped and/or glued in place, it should be possible to perform testing without undue risk of circuit damage but consider a replacement flyback as a long-term solution.

3. Internal shorts in the focus/screen divider network, if present. One sign of this may be arc-over of the focus or screen spark gaps on the PC board on the neck of the CRT.

4. Internal shorts in the windings.

5. Open windings.

More than one of these may apply in any given case. As noted, temporary repair at least is sometimes possible for failures 1 and 2. For failures 3 to 5, replacement is usually the only alternative.

## Initial Tests

**Warning:** Before proceeding, make sure you have the TV or monitor unplugged and confirm that the main filter capacitor(s) and CRT have been safely discharged!

For these first tests, you'll only be using your senses and perhaps a multimeter. First, perform a careful visual inspection with power off. Look for cracks, bulging or melted plastic, and discoloration. Look for bad solder connections at the pins of the flyback as well. If the TV or monitor can be powered safely, check for arcing or corona around the flyback and in its vicinity.

Next, perform ohmmeter tests for obvious short circuits between windings; look for greatly reduced winding resistances and open windings. Don't neglect to check between the CRT HV connector (suction cup) and the pins on the base; that should measure infinity.

For the low-voltage windings, service manuals may provide the expected DC resistance (*Sams' Photofact*, for example). Sometimes, that will change enough to be detected—if you have an ohmmeter with a low-enough scale as these are usually a fraction of an ohm. It is difficult or impossible to measure the DC resistance of the HV winding since the rectifiers are usually built in. The value is not published either.

Any measurements that are much less than the published values likely indicate a partially shorted winding. However, a difference of 10% might not be significant at all. Higher than normal readings



might simply indicate that a design change was made.

Of course, any continuity between separate windings is definitely a fault.

Partially short-circuited windings (perhaps, just a couple of turns) and sometimes shorts in the focus/screen divider will drastically lower the Q and increase the load the flyback puts on its driving source with no outputs connected. Those types of failures, which are not detectable by simple ohmmeter tests or visual inspection, require the troubleshooting techniques described in the "Advanced Testing" section, a little later in this article.

It is also possible that various types of flyback faults can damage other circuitry (beyond taking out the horizontal-output transistor and its associated parts). Therefore, if shorts are detected in the flyback, it is worth testing some of the components in the vicinity, and *vice-versa*.

## The Process of Elimination

Before attempting the more advanced tests suggested below, there may be ways of being more certain that your flyback is the problem component. The following assumes that running the TV or monitor with the suspect flyback results in an excessive load on the low voltage (B+) power supply, blowing a fuse (or attempting to blow a fuse—excessively bright series light bulb). The B+ likely drops from its normal 65 VDC to 140 VDC or more (depending on the actual TV or monitor and mode) to some low value like 25 VDC when measured on the low-voltage power-supply side of the flyback-drive winding. (Measuring at the HOT can result in all sorts of weird readings due to the pulse nature of the waveform and is not recommended—especially when everything is working properly—since there you will be dealing with 1500 V pulses!)

- Disconnect all the secondary loads from the suspect flyback including the CRT. Connect only the drive (B+ and HOT). Power up the TV or monitor (preferably with a series light bulb or on a Variac). If the B+ now climbs to a more normal value, a problem with the HV (CRT short) or one of the secondary loads is indicated. Connect each of these up one a time (or test individual components) to localize the fault. The flyback is likely good.

- Remove the suspect flyback and connect just the HOT and B+ to the drive winding of a known good flyback

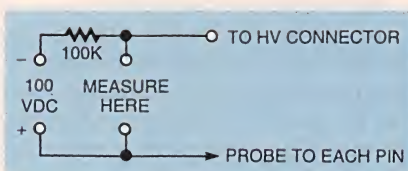
for a similar size TV or similar type of monitor (as appropriate). It may be close enough to keep the drive circuitry happy. Power up the TV or monitor (preferably with a series light bulb or on a Variac). If the B+ now climbs to a more normal value, a problem with the original flyback is indicated. However, more thorough testing may be desirable to be absolutely certain.

If you do this regularly, keeping a selection of "flyback simulators"—just the drive windings and cores—might be desirable.

## Advanced Testing

When the basic tests are inconclusive, there are several ways of testing flybacks (assuming you do not actually have special test equipment for this purpose). Here are two possibilities. The first is easier if you have a scope, but the second is more fun.

**Method 1:** The following technique works for flybacks; chopper transformers; motors; mains transformers; deflection-yoke windings; VCR, video, and other magnetic heads; and other transformers, coils, or inductors. It is called a "ring test" and is the method often used by commercial flyback (or other coil/transformer) testers. The theory is that a faulty flyback will have shorted turns in one of the coils. In such a case, the Q of the transformer is greatly reduced. If excited by an impulse, a faulty transformer will resonate with a



**FIG. 3**—IT IS IMPORTANT TO LOCATE the HV return. This circuit makes that easier to do.

highly damped oscillation while a good one will decay gradually.

- Connect a high quality capacitor across a larger winding (not the filament) of the suspect device; see Fig. 1. Hope for a resonant frequency of a few kHz. You may need to select the capacitor value for best results. I have found that a capacitor in the 0.001- to 1- $\mu$ F (non-polarized) range will usually be satisfactory.

- Apply a pulse waveform to the parallel-resonant circuit. In 1960, most scopes had a "sync out" on the time base that provided a few tens of volts at

enough current for this. If you don't have one of these, use a simple 555 astable circuit or function generator.

- Look at the waveform across the resonant circuit with a scope. A good unit will give a nicely decaying oscillation, of at least a few cycles, possibly tens of cycles. If there is a shorted turn **anywhere** in the device, the oscillations will be seriously damped, and you'd be lucky to see two complete cycles. Experience and/or comparison with a known good device will tell you what to expect.

**Method 2:** The circuit in Fig. 2 excites the flyback in much the same way as in normal operation; note that none of the component values in the circuit are particularly critical. The only caution is that this tester probably does not put enough stress on the flyback to find an intermittent that fails only under full operating conditions. However, most flyback failures are solid—once a short develops, there is a meltdown of sorts and it is there to stay.

You will need a 12 V power source of at least 2 or 3 amps capacity (regulation is not important—I just use a simple transformer, rectifier, filter capacitor type of power supply). If the circuit does not start oscillating at about 5 volts or less, interchange the two feedback connections to the transistor bases.

The tester is just a chopper feeding the salvaged core from an old flyback (I removed the inductance control spacers for this core). The drive (5T+5T) and feedback (2T+2T) coils can be wound from hookup wire (#14-#20) and well insulated with plastic electrical tape. Connect the center taps directly to the coils—do not bring out a loop of wire. Make sure all the turns of each coil are wound in the same direction. Wind the feedback coil directly on top of the drive coil. The secondary of this core is a 10-turn well-insulated coil similar to the other two wound on the opposite side of the ferrite core.

You will need to remove the suspect flyback from the TV or monitor. Another 10-turn coil is wound on the suspect flyback core anywhere it will fit. Connect one end of this coil to one end of the 10-turn coil on your old flyback core. Use a wire nut or twist together securely. Provide an easy way of connecting the other ends momentarily—a pushbutton comes in handy.

Make sure you locate the HV return lead on the flyback and use that as the return for the arc. Otherwise, you may



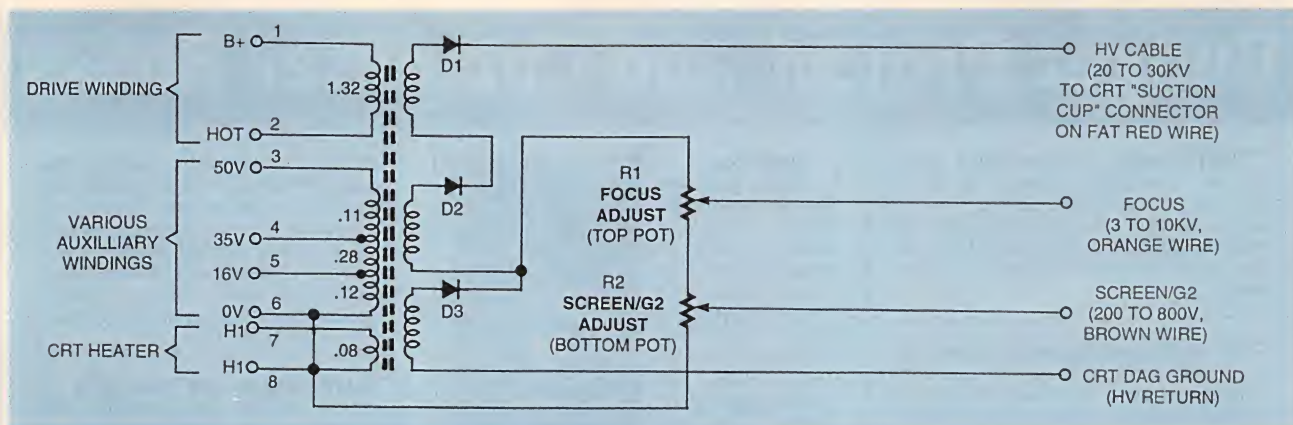


FIG. 4—A SCHEMATIC DIAGRAM of a typical flyback. Note the resistance values shown are illustrative and may differ widely from the ones on your unit.

puncture the insulation when the high voltage finds its own path to ground. There are several approaches that can be taken to identify the lead—possibly in combination:

- Process of elimination—the HV return will often be an isolated pin on the flyback not connected to anything else. Check with ohmmeter.

- Check all connections on the circuit board and identify those that go to ground. One of those flyback pins will be the HV return. It will do no harm to connect them all to ground during testing.

- Use a 100-VDC or greater power supply and a high-value resistor, say 100K in the set up shown in Fig. 3. Connect the power supply negative output through this resistor to the HV lead on the flyback (suction cup connector). Check each pin on the base of the flyback with the probe. Touching the return pin will result in the voltage reading dropping to perhaps 50 or 60 volts. This is the forward voltage drop across the high-voltage rectifier stack inside the flyback. All other pins will result in it remaining at the supply voltage.

Once the HV return is found, the circuit in Fig. 2 is wired, and everything is double checked, it is time to “turn on the juice.”

- If the flyback is good, then with the coils connected there will be several kV at its output—enough to create a small arc (1/8-inch typical, up to 1/2-inch for color flybacks).

- The load imposed on the oscillator will be modest (the frequency increases in response to load). If there are any shorted windings, then there will be no significant HV output and the load on the oscillator will increase dramatically.

- If you get arcing or corona from

under the flyback—at the pins—either you did not locate the correct HV return or there is a short inside resulting in HV arcing internally to the low voltage windings.

I have used this “tester” on a dozen or so flybacks. It has never been wrong (though I have opted not to believe it and gotten in trouble).

### Flyback-Testing Equipment

Sencore and others sell test equipment that includes the “ring test” or similar capabilities built in. For the professional, these are well worth the expense. However, a hobbyist could probably purchase lifetime TV replacements for the cost of one of these fancy gadgets.

Bob Parker has now designed an inexpensive, easy-to-use LOPT/Flyback Tester available through Dick Smith Electronics. Information is available at: [www.nlc.net.au/~bobp/fbt.htm](http://www.nlc.net.au/~bobp/fbt.htm) (Bob Parker's FBT Page). This (along with his ESR meter) have been highly recommended on the [sci.electronics.repair.newsgroup](http://sci.electronics.repair.newsgroup).

Other flyback testers are described at: [www.usit.com/kephart/flyback.htm](http://www.usit.com/kephart/flyback.htm) (Kephart's FBT Page) and [www.vaag.es/producc/art/hr-stvdst-01/index\\_en.htm](http://www.vaag.es/producc/art/hr-stvdst-01/index_en.htm) (VAAG FBT Page). Various electronics magazines have published construction articles for various types of simplified versions of these devices as well.

### Testing for Bad High-Voltage Diodes

A single diode failure would be tough to find if it is in series with other diodes (as is typical on larger flybacks) as it would only be a problem when run near full output. However, this sort of failure

is unlikely.

General diode failure (shorts) would probably not be detected with the sorts of tests described above or with typical flyback-testing equipment. Actually, a simple ohmmeter test between the HV output and return might suffice! If this doesn't reveal anything, I suggest the following:

One possible way to test for this would be to attach a high-voltage capacitor between the HV output and return of the flyback. If the diodes are good, the tester's excitation should then charge this cap up (watch out—the voltage might get to be quite high!). While charging, this load will make the flyback fail any ring test. Once charged, it should pass. However, if the diodes are shorted, I would expect the flyback to test bad as the cap will continue to present an AC load on the output and never charge properly.

### Typical Flyback Schematic

The diagram in Fig. 4 shows a typical flyback that might be found in a direct-view color television or computer monitor. Resistances are included for illustrative purposes only and may be quite different on your flyback.

The high-voltage section on the right might actually be constructed as a voltage multiplier rather than a single winding with multiple HV diodes. The rectifiers or multiplier, and/or focus/screen divider might be external to the flyback transformer in some models.

Flyback transformers used in black-and-white TVs and monochrome computer monitors do not have a focus and screen divider network. Older ones do not include a high-voltage rectifier

(Continued on page 87)



# Budget Project and Computer Books

☐ **BP317—Practical Electronic Timing \$6.99.** Time measurement projects are among the most constructed gadgets by hobbyists. This book provides the theory and backs it with a wide range of practical construction projects. Each project has how-it-works theory and how to check it for correct operation.

☐ **BP415—Using Netscape on the Internet \$8.99.** Get with the Internet and with surfing, or browsing, the World Wide Web, and with the Netscape Navigator in particular. The book explains: The Internet and how the World Wide Web fits into the general scenario; how do you go about getting an Internet connection of your own; how to download and install the various versions of Netscape browsing software that are available; and how to use Netscape Navigator to surf the Web, and to find and maintain lists of useful sites. There's a heck of a lot more, too!

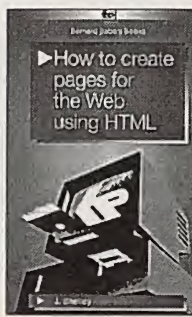
☐ **BP325—A Concise User's Guide to Windows 3.1 \$6.99.** Now you can manage Microsoft's Windows with confidence. Understand what hardware specification you need to run Windows 3.1 successfully, and how to install, customize, fine-tune and optimize your system. Then you'll get into understanding the Program Manager, File Manager and Print Manager. Next follows tips on the word processor, plus how to use Paintbrush. There's more on the Cardfile database with its auto-dial feature, Windows Calendar, Terminal, Notepad, etc.

☐ **BP327—DOS: One Step at a Time \$5.99.** Although you spend most of your time working with a word processor, spreadsheet or database, and are probably quite happy using its file management facilities, there will be times when you absolutely need to use DOS to carry out 'house-keeping' functions. The book starts with an overview of DOS, and later chapters cover the commands for handling disks, directories and files.

☐ **PCP119—Electronic Music and Midi Projects \$12.95.** Save cash by building the MIDI gadgets you need. Want a MIDI THRU box, program change pedal, Metronome, analog echo unit, MIDI patchbay or switcher? Over 16 practical and very useful music and MIDI projects—all in this book! The projects are explained in detail with full instructions on assembly.

☐ **PCP120—Multimedia on the PCI \$14.95.** What is Multimedia? What can it do for you? It can do lots of nice things! This 184-page book helps you create your own multimedia presentation. Multimedia applications by people like you can revolutionize educational and business applications as well bring more fun, fun, fun into your leisure computer activities.

☐ **BP404—How To Create Pages for the Web Using HTML \$7.99.** Companies around the world, as well as PC users, are fast becoming aware of the World Wide Web as a means of publishing information over the Internet. HTML is the language used to create documents for Web browsers such as Mosaic, Net-scape and the Internet Explorer. These programs recognize this language as the method used to format the text, insert images, create hypertext and fill-in forms. HTML is easy to learn and use. This book explains the main features of the language and suggests some principles of style and design. Within a few hours, you can create a personal Home Page, research paper, company profile, questionnaire, etc., for world-wide publication on the Web.



☐ **BP377—Practical Electronic Control Projects \$7.99.** Electronic control theory is presented in simple, non-mathematical terms and is illustrated by many practical projects suitable for the student or hobbyist to build. Discover how to use sensors as an input to the control system, and how to provide output to lamps, heaters, solenoids, relays and motors. Also the text reveals how to use control circuits to link input to output including signal processing, control loops, and feedback. Computer-based control is explained by practical examples.

☐ **BP411—A Practical Introduction to Surface Mount Devices \$6.99.** This book takes you from the simplest possible starting point to a high level of competence in working with Surface Mount Devices (SMD's). Surface mount hobby-type construction is ideal for constructing small projects. Subjects such as PCB design, chip control, soldering techniques and specialist tools for SMD are fully explained. Some useful constructional projects are included.

☐ **BP136—25 Simple Indoor and Window Aerials \$2.99.** Many people live in flats and apartments where outdoor antennas are prohibited. This does not mean you have to forgo shortwave listening, for even a 20-foot length of wire stretched out under a rug in a room can produce acceptable results. However, with experimentation and some tips, you may well be able to improve further your radio's reception. Included are 25 indoor and window antennas that are proven performers. Much information is also given on shortwave bands, antenna directivity, time zones, dimensions, etc. A must book for all amateur radio enthusiasts.

☐ **BP379—30 Simple IC Terminal Block Projects \$6.99.** Here are 30 easy-to-build IC projects almost anyone can build. Requiring an IC and a few additional components, the book's 'black-box' building technique enables and encourages the constructor to progress to more advanced projects. Some of which are: timer projects, op-amp projects, counter projects, NAND-gate projects, and more.

☐ **BP401—Transistor Data Tables \$7.99.** The tables in this book contain information about the package shape, pin connections and basic electrical data for each of the many thousands of transistors listed. The data includes maximum reverse voltage, forward current and power dissipation, current gain and forward transadmittance and resistance, cut-off frequency and details of applications.

☐ **ETT1—Wireless & Electrical Cyclopedica \$4.99.** Step back to the 1920's with this reprinted catalog from the Electro Importing Company. Antiquity displayed on every page with items priced as low as 3 cents. Product descriptions include: Radio components, kits, motors and dynamos, Leyden jars, hot-wire meters, carbon mikes and more. The perfect gift for a radio antique collector.

☐ **BP93—Electronic Timer Projects \$2.99.** This book covers many of the possible applications of timer circuits. These circuits may turn on or off at either some preset time or after an elapsed time. Some of the more complicated timer and clock circuits are made up from a number of simpler circuits that the author deals with individually. Also included are several special interest circuits such as cars windshield wiper delay unit, a darkroom timer, metronome, etc.

☐ **BP88—How To Use Op-Amps \$5.99.** Written as a designer's guide covering many operational amplifiers, serving both as a source book of circuits and a reference book for design calculations. There are chapters on Meet the Operational Amplifier, Basic Circuits, Oscillators, Audio Circuits, Filters, Miscellaneous Circuits, Common Op Amps, Power Supplies and Construction Notes and Fault Finding.

☐ **BP76—Power Supply Projects \$3.99.** Presents a number of power-supply designs including simple unbiased types, fixed voltage-regulated types and variable voltage stabilized designs. All are low-voltage types intended for use with semiconductor circuits. Apart from presenting a variety of designs that will satisfy most applications, the data in this book should help the reader to design his own power supplies. An essential addition to the experimenters electronics library.

**ELECTRONIC TECHNOLOGY TODAY INC.**  
P.O. BOX 240, Massapequa, NY 11762-0240

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

**SHIPPING CHARGES IN USA AND CANADA**  
\$0.01 to \$5.00.....\$2.00  
\$5.01 to \$10.00.....\$3.00  
\$10.01 to \$20.00.....\$4.00  
\$20.01 to \$30.00.....\$5.00  
\$30.01 to \$40.00.....\$6.00  
\$40.01 to \$50.00.....\$7.00  
\$50.01 and above.....\$8.50

**SORRY No orders accepted outside of USA & Canada**

No. of Books Ordered   
Total price of books ..... \$ \_\_\_\_\_  
Shipping (see chart) ..... \$ \_\_\_\_\_  
Subtotal ..... \$ \_\_\_\_\_  
Sales Tax (NYS only) ..... \$ \_\_\_\_\_  
Amount Enclosed ..... \$ \_\_\_\_\_

All payments must be in U.S. funds!



# Pirate Radio

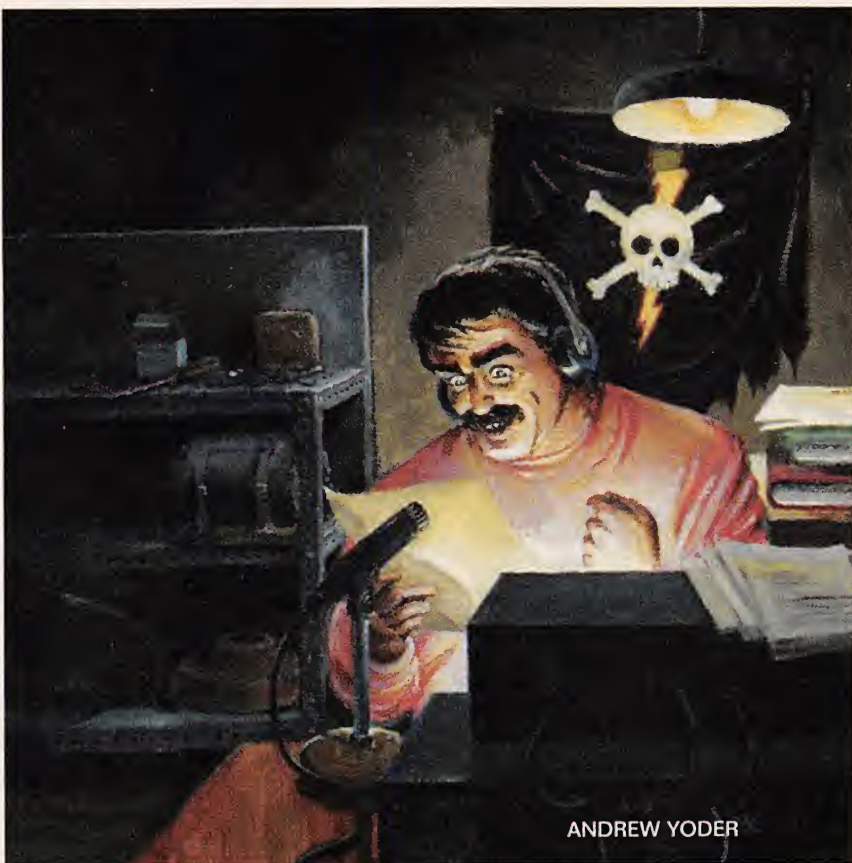
*Shiver me timbers, here's a look inside the never boring world of clandestine broadcasting, more colorfully known as "Pirate Radio."*

**R**adio tubes are glowing in the dim, electronics-equipment-strewn room. The aroma of incense laces the air. Steve Mann tunes around the shortwave frequency of 6955 kHz one last time to check for other stations using the channel. The radio emits only the light crackle of atmospheric noise. He leans over, flicks a switch on an aging amateur radio transmitter, and punches the play button on his cassette deck. Radio Eclipse is on the air.

As the opening "signature" (interval signal) is playing, short-wave listeners from Ontario to Texas begin tuning in. Others dial up the Internet to let friends know that Radio Eclipse is broadcasting a new program.

Meanwhile, back at the clandestine studio of Radio Eclipse, the strains of "Everybody Wants You" by Billy Squire die down. Steve Mann begins the much-anticipated "News of the Week" segment. As usual, Steve mixes factual news with shortwave culture and complete nonsense...producing often-hilarious results. In the past, Mann had aired everything from barbs at sportscaster Marv Albert to announcing a "list" of Andrew Cunanan's potential victims that the station "discovered." This week, however, Mann sticks with safer targets, namely those involved with the goings-on in Washington.

After a few more songs, fake ads, station-address announcements, and more of the interval sig-



nal, Mann turns off the tube finals and puts the transmitter in standby mode to cool off. Just after turning the receiver back on, the static is broken by the words "Good show, Steve." Mann flicks off the standby switch. So ends the broadcast day of Radio Eclipse.

As you might have guessed, Radio Eclipse is a pirate station—one of those almost-mythical phenomena that have been quietly making the headlines for the past decade, but that few people seem to have heard or really know anything about. Sure, many have seen

articles about Stephen Dunifer of Free Radio Berkeley, who has tied the FCC up in court for several years or about Radio Newyork International or Radio Caroline (from England), both of which broadcast from large vessels in international waters. But how many have actually heard a pirate?

Stations have been pouring on to the airwaves over the past five years in the United States and Canada. By the FCC's estimates, 300 pirate stations were broadcasting from the U.S. going in to 1998, but these numbers are certainly conservative. Miami, Florida alone has boasted approximately 20 stations in 1998! A radio pirate in your hometown might even have escaped your attention. So, then, who are these pirates and what is the hoopla all about?

## ABOUT THE AUTHOR

Andrew Yoder publishes *Hobby Broadcasting* magazine. He has also written the following books about pirate radio: *Pirate Radio Stations*, *Pirate Radio*, and *Pirate Radio Operations*. He can be contacted at: [ayoder@cvn.net](mailto:ayoder@cvn.net) or P.O. Box 642, Mont Alto, PA 17237.



has been in court with the FCC for several years over their right to broadcast. But the group has done much more than just create legal hassles for the FCC. FRB has also worked hard to spread pirate radio (called "microradio" or "microcasting" by those devoted to the cause) to the masses. Stephen Dunifer has sent out regular press releases, newsletters, and com-

more stations began broadcasting.

Now it seems that in any city of 100,000 or greater, at least a few FM pirates are broadcasting, either on a set schedule or irregularly. The larger cities have literally dozens of pirates, some of which are broadcasting on a 24-hour-per-day/7-days-a-week basis. For example, when the FCC swept into Miami, Florida in the summer of 1998, it raid-

since the AM "expanded band" opened in the U.S. Long-distance U.S.-based radio pirates have largely disappeared because any such stations appearing within the band are for the most part crowded out by much more powerful signals from commercial stations at night. But AM pirating lives on in other countries. Dozens of stations from the Netherlands crowd the area from 1580 to 1630 kHz, and pirates from Greece and Yugoslavia often can be heard there as well. These days, if any North American pirate would like to broadcast on a clear nighttime channel, it would be necessary to move to 1710 or 1720 kHz. But will anyone be listening?

**Shortwave Pirates.** For decades, the shortwave frequencies have been a favorite pirate hangout. Those on the outside might wonder why anyone would waste their time broadcasting on frequencies that many can not receive. But upon further inspection, you can see that the shortwave bands and pirate radio seem almost made for each other.

Your Alternative to the Alternative! 6955 USB-AM

RADIO ECLIPSE



Steve Mann

95 WATTS USB  
150 WATTS AM

A business card from Steve Mann's Radio Eclipse pirate radio station.

ments concerning Free Radio Berkeley in particular, and the uncensored radio scene in general, to the FCC and major mass-media outlets across the country.

The press releases and newsletters helped keep Free Radio Berkeley and other unlicensed broadcasters in the news in the San Francisco Bay area, and as a hot feature across the country. But Free Radio Berkeley did more than just inspire others to broadcast. They actually helped put other stations on the air by producing transmitter kits so that other like-minded people could have their own piece of the airwaves.

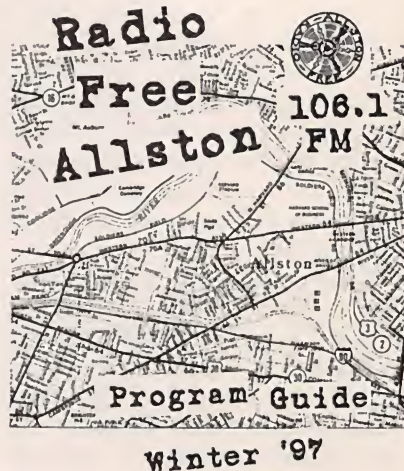
As a result, stations began popping up across the FM band around the United States, many using the FRB transmitters. The motivation was simple; most radio enthusiasts seem to believe that licensed radio has abandoned community and niche programming. Before long, companies such as Veronica, Broadcast Warehouse, and others were manufacturing higher-powered FM transmitters and marketing them in the United States. The competition lowered the transmitter prices, and even

ed 15 different FM pirates that were broadcasting on a regular basis. Within a month of the enforcement actions at least five new pirate broadcasters, all operating on regular schedules, could be heard.

The same story is being repeated across the country. Stations begin broadcasting, the FCC closes some of them down, and more operations come to life. As the FCC raids more stations, the pirates become more resourceful and more determined. It appears that some huge events are on the horizon for unlicensed FM broadcasting.

**AM Pirates.** For decades, AM pirate radio mostly occurred at the top end of the AM-broadcast band. The earliest well-known AM pirates began broadcasting there in the 1960s and 1970s. From that point on, the 1615- to 1635-kHz range was pirate territory. In the late 1970s and early 1980s, pirates such as WFAT, Pirate Radio New England, WART, WDX, WENJ, KPRC, KW Radio, Free Radio 1615, and many others would have hundreds of listeners, often receiving dozens of calls during every broadcast.

Much has changed, however,



Some pirate stations broadcast on a fixed schedule and even provided a program guide such as this one from a suburban Boston operation.

The greatest advantage of shortwave is its ratio of signal coverage to power. The typical 10-watt FM station will only cover anywhere from a few blocks to a few miles, depending on the height of the antenna and the obstacles in its path. However, with a decent antenna, 10 watts on shortwave



can easily cover several hundred miles during the daytime or 1000 miles at night.

Obviously, if shortwave signals can cover such a huge territory, these stations are much more difficult to locate using direction-finding (DFing) equipment. The pirate could be anywhere! Also, short-wave signals can reflect off large

ule, were staffed by volunteers from the community and often operated from a fixed location. For the most part, the shortwave stations were more careful and operated only a few hours per month, but still mostly from homes or other permanent locations.

But in November 1997, the FCC began to put the squeeze on much

station owners were cuffed, face down on the floor, agents from numerous government agencies rifled through personal possessions, confiscating radio equipment, audio equipment, and music collections.

The enforcement activities continued throughout 1998. Outspoken opponents of the FCC, such as Radio Mutiny (Philadelphia), Free Radio Berkeley, and others were all closed down. The FCC claimed more than 200 raids against pirates in 1998.

But the stations haven't disappeared; if anything, they've become more resourceful. Radio Mutiny was perhaps the master of strategic publicity. After a publicity campaign, the station broadcast from the site of the Liberty Bell. They stated that if their voice of liberty was wrong, then the FCC was justified in raiding the station there, in front of our nation's symbol of liberty and the TV cameras. The FCC was apparently camera shy and the broadcast was a success. Armed with the promise of a media blitz, a female announcer broadcast from their studios completely naked that night, daring the FCC to close the station. Again, another success. When Radio Mutiny was eventually raided, the FCC waited until no one was around and the station was off the air.

At a low-power FM conference in Washington, DC in October 1998, attendees marched to the buildings of the FCC and the National Association of Broadcasters (NAB). As the parade reached the front of



A QSL card from 1970s pirate WFAT in New York City.

buildings, hills and mountains, water towers, etc. and provide false signals for those who are attempting to locate the station.

The vast distances and many borders traversed by shortwave signals give those frequencies the final advantage. Who wouldn't feel compelled to tune in mysterious broadcasts from great distances? For example, in the 1970s and 1980s, Russian pirates, called "radio hooligans" by Soviet officials, often broadcast in the 2000- to 4000-kHz region. After the fall of communism in the Soviet Union, the Russian pirate Radio Without Borders International was heard all over Europe (and even in Canada) with its pro-Western pop music format.

**Recent Enforcement Actions.** Until relatively recently, pirate stations, both on shortwave and FM, have been broadcasting with reckless abandon, sometimes for several years. Many of those FM stations bluntly challenged the FCC's rules and their right to enforce them. These stations, particularly the ones that operated on a regular sched-

of the carefree broadcasting. The first action was an attack on a trio of FM stations (87X, Lutz Community Radio, and The Party Pirate) in the Tampa, Florida area. Those raids were notable because the FCC exercised considerable force to close down the community stations. Those who owned the stations were awakened in the early morning hours, with SWAT teams aiming automatic weapons at them. While the

#### Some Active North American Shortwave Pirates

Blind Faith Radio	Testing and 1960s/1970s album rock.
Free Hope Experience	A weird mixture of UFOs, free speech, and comedy skits.
Mystery Radio	All-instrumental synthesized music—very mysterious!
Radio Azteca	Homebrew comedy all related to shortwave listening.
Radio Eclipse	A wide variety of music and elaborate parodies.
Radio Free Speech	Professional mix of novelty music, fake ads, and free speech editorials.
Radio Metallica Worldwide	Rock and metal music, plenty of R-rated discussions.
WACK	Rock music and telephone call-ins.
WEED	Collage-style mixes of rock and punk music, with snips of audio from speeches and movies.
WLIQ	Mostly rockabilly music.
WLIS	"We Love Interval Signals"—interval signals from stations around the world and some rock music.
WMPR	Techno music and brief IDs.
WSRR	"Solid Rock Radio" Rock, rap, and soul music, with some Christian sermons.



the FCC building, a 10-watt FM transmitter was turned on and Radio Mutiny began broadcasting, speaking out against FCC control of the airwaves. The FCC again took no action.

In late November, two radio activists in Berkeley, California broadcast for days, 50 feet up in a redwood tree as "Tree Radio Berkeley." According to several reports, the pair had received considerable media attention and vocal support



*Mystery radio is one of a number of active (as of this writing) North American shortwave pirates. See the sidebar for others.*

from people in the community. It was also reported that the FCC's first attempt to serve the pair a Notice of Apparent Liability failed because they couldn't find a way to get the papers up the tree!

On shortwave, activity in the United States has decreased significantly following raids on four different pirates around the country this past October. Unlike the direct-confrontation approach taken by many FM stations, the shortwave pirates have simply disappeared, apparently awaiting the time that "the coast is clear."

**Tuning In To Pirate Radio Stations.** If you live in a city or in the suburb of a major city, you have the opportunity to hear FM pirates. But they can be difficult to locate. In many large cities; the radio spectrum is nearly full. The best way to

## The History Of Unlicensed Radio

Without a doubt, pirate radio goes back to the earliest days of broadcasting. The first broadcasts ever were made by Reginald Fessenden on Christmas Eve 1906. Just like the pirate broadcasts that would appear nearly a century later, Fessenden's program appeared on a holiday without a schedule; was relatively short; featured variety show music, talk, and readings; and it surprised those who tuned in. Of course, Fessenden's broadcasts were also unlicensed. According to many accounts, these types of unlicensed, hobby broadcasts occurred through the teens, up through the early 1920s when the Federal Radio Commission (predecessor of the FCC) banned unlicensed broadcasting and broadcasting by amateur-radio operators.

It wasn't long until pirates began actively challenging the authority of the FRC. The first-known "true" pirate was WUMS ("We're Unknown Mysterious Station"), which operated irregularly from the banks of the Ohio River from 1924 until 1948. Station operator David Thomas even built a secret transmitter into a table and managed to foil the FCC in court in 1938 and 1948—even though he had been sentenced to four years in prison and an \$8000 fine. The real end for WUMS came not from the FCC, but from the operator himself. Thomas died of cancer in 1983, soon after testing a new transmitter that would have put WUMS back on the air.

Other early mentions of pirate radio are difficult to find, but are recorded, nonetheless. For example, *Zenith Radio: The*

*Early Years* by John Bryant and Harold Cones features a photo from when the Zenith flagship radio station decided to defy the FRC's ruling concerning their frequency in 1927. The station staff all donned pirate costumes for the broadcast! And a 1930s issue of *RADEX*, a radio-listening magazine, mentions one listener who received QSL cards from several different Ohio AM pirates.

Pirate radio slowed down for World War II, replaced instead by clandestine radio and espionage. The Cold War of the 1950s also was tough on the independent broadcasters. But as the commercial pirates (such as Radio Caroline, Radio London, Radio Mercur, Radio City, and others) began to take to the airwaves off the coast of Northern Europe in the late 1950s and early 1960s, pirate radio suddenly caught the interest of a new generation. In addition to inspiration from the Europeans, American enthusiasts were aided by then-inexpensive World War II surplus equipment, Lafayette phono oscillators, and such underground works as *The Anarchist Cookbook*.

By the 1970s, pirate radio was a fully established niche and some radio hobbyists even labeled themselves as "pirate radio listeners." The situation was especially well entrenched in Europe, where some shortwave pirates were receiving literally hundreds of letters for just a Sunday morning broadcast. Activity was not nearly as organized in North America during the 1970s, but still numerous stations were active during the decade.

look for FM pirates is to get to know the broadcast spectrum and frequently tune the clear channels. Otherwise, it's a good idea to regularly read the alt.radio.pirate newsgroup on the Internet, check the local record shops and alternative weekly papers, and read *Hobby Broadcasting* magazine (see the "About the Author" box). Once you know that a station is active on a given frequency, then you can tune in whenever you have a chance and see if anything turns up.

Shortwave is very different. You don't need to really know a huge variety of frequencies. Instead, most pirates congregate around several well-known, clear frequencies. The current prime frequency area is plus or minus several kilohertz of 6955 kHz, just below the 40-meter amateur band. Also, one of the best-heard pirates of recent years is Radio Metallica Worldwide, which has

been using 7415 kHz when a licensed station (WBCQ) that also uses that frequency is off the air. Most pirates broadcast during the weekend afternoons and evenings, although when activity was peaking in 1997 and 1998 (before the FCC raids), weekday-evening broadcasts were not uncommon.

The European pirates typically use the frequencies between 3900 and 3950 and also 6200 to 6300 kHz. The former range is used primarily at night and the latter is used during Sunday mornings. Often, more than one and sometimes two dozen stations broadcast every weekend, but these are very difficult to hear in North America because 3900-3950 kHz is part of the North American 80-meter ham band and signals in the 6200- to 6300-kHz range don't travel far in the daytime.

*(Continued on page 44)*





# Night Vision for your CAR

*Night driving just got much safer thanks to this new system from Cadillac*

Night vision technology is now routinely used by the military, law enforcement, fire departments, TV-news cameramen, and others who have to "see" in darkness. Starting in the year 2000, it will also be used by drivers of the new DeVilles as Cadillac is set to be the first automaker to offer night vision on a production vehicle.

Cadillac's Night Vision will make nighttime driving safer by helping drivers see objects that would otherwise remain in the dark. While nighttime driving represents only about a quarter of total miles driven, according to data from the National Highway Traffic Safety Administration (NHTSA), it accounts for more than half of all traffic fatalities. While many other factors, such as fatigue, contribute to this increase in nighttime crashes, decreased visibility certainly plays a significant role.

Cadillac Night Vision will help drivers see beyond the range of their head lamps. However, it is not intended to be a "drive-by" system or to replace a driver's view out of the windshield. What it will do is give drivers additional visual information

beyond what their unaided eyes are capable of seeing. Depending on conditions, with Night Vision drivers will see three to five times farther down the road than with just low-beam headlamps. Night Vision can also help drivers see beyond the blinding headlamp glare from oncoming vehicles or spot a deer amongst the dried brush at the edge of the road.

**How It Works.** Technically, the title "Night Vision" is a bit of a misnomer since that term is usually associated with image intensification (II) technology used commonly in night-vision goggles. Instead, the Cadillac system uses thermal imaging (TI), or infrared (IR) detection. Thermal imaging is based on the differences in heat energy emitted by all objects in a scene being viewed. Everything emits heat to some degree, but humans, ani-

mals, and moving vehicles are more visible in the TI image because of their high thermal contrast compared to the background. Drivers view the TI scene on a heads-up display (HUD) developed by Delphi-Delco Electronics.

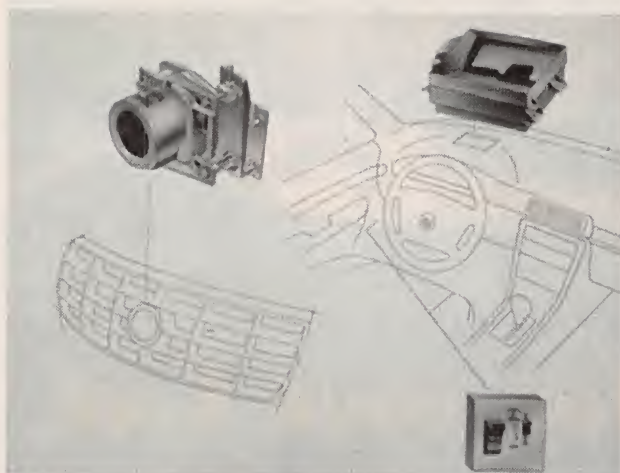
The IR detector on Cadillac's Night Vision system (developed by Raytheon Systems Co.) uses an uncooled focal plane array (UFPA) made of barium-strontium-titanate (BST), a ferroelectric material. One important property of that sensor is that it operates at room temperature to measure the thermal energy of objects that are invisible to the human eye; while detector temperatures are stabilized with thermoelectric coolers, there is no attempt, nor need, to achieve the cryogenic temperatures used in similar detectors.

No mechanical scanner is required to serially trace out object space to produce an image. Instead, each pixel of the one-inch UFPA detector "stares" out into space continuously, the scene energy is modulated, and the image is then produced by electronically scanning or reading out the detector array. The

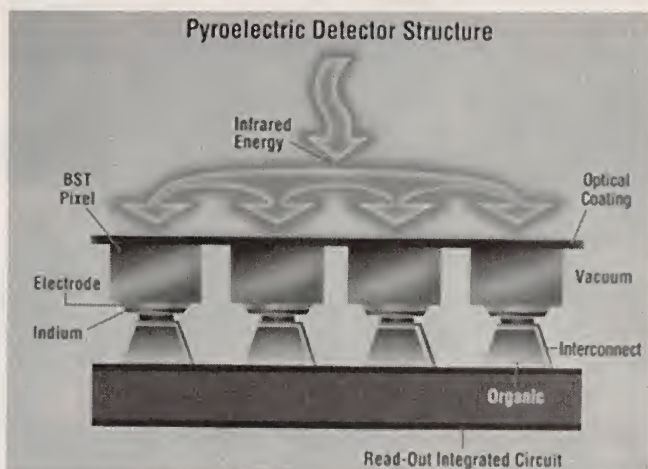
## FOR MORE INFORMATION

**Cadillac Communications**  
100 Renaissance Center  
Detroit, MI 48265-1000  
Tel: 800 760-4078





Three key components in Cadillac's Night Vision system include the IR detector (behind the grille), the HUD, and the controls.



The IR detector consists of a barium strontium titanate reticulate structure bonded to a readout integrated circuit.

UFPA has 320 horizontal IR sensing elements and 240 vertical elements. Thermal energy is focused on the detector, using optics designed to pass infrared wavelengths. Each element is a temperature-dependent capacitor that changes capacitance depending on how much IR energy is received. A chopper disc rotates in front of the detector to modulate the scene's energy by allowing the pixels to view the scene and then an absence of scene. It rotates in phase with the detector read-out circuitry timing. The circuit under each element samples capacitance on a regular basis, and those readings are converted into a monochromatic video signal in which hotter objects in the scene appear white.

Refractive optics, chosen because of their smaller package, are mechanically controlled internally to keep the system in focus over the anticipated tempera-

ture range. The optics, similar to those used in visible-light cameras, refract the IR rays from the object to the detector.

After considering factors like sensor size, vibration, dirt, damage from stones, and weather and temperatures, Cadillac located the sensor behind the center of 2000 DeVille's grille. There it has an unobstructed view of the road and can be kept reasonably clean by just washing the car. It is equipped with a window to protect the optics as well as to provide a durable surface to clean. An internal heater prevents snow and ice build-up on the window.

The HUD is integrated into the dash in front of the driver and projects a virtual image that appears in the driver's peripheral vision above the instrument pod, where it does not obstruct the view of the road. Drivers can glance at the virtual image without refocusing or

removing their eyes from the road, much like they use rear-view mirrors. The image has a horizontal field of view of 11 degrees and a vertical field of view of 4 degrees. Objects in the image are the same size as the objects in the road scene helping drivers better judge the distance to an object. The virtual image looks somewhat like a black and white photographic negative with hotter objects the driver cares about most—i.e. people, animals, and moving vehicles—standing out from the black background of the cooler objects. Having the HUD image projected below the driver's line of sight also helps the driver handle headlamp glare from oncoming vehicles. The image location is ideal since the drivers tend to naturally look downward to avoid the glare.

The system operates only at night, when the head lamps are on and the "Twilight Sentinel" photo cell indicates it is dark. A switch controls image position and intensity. The image position is adjusted by moving a mirror in the HUD so the virtual image is moved up and down to the desired position.

Night Vision can help even when you are not driving down the road. For example, it can enhance personal safety by detecting a person hiding in the dark near homes, offices, and parking lots. It can also help drivers see someone changing a tire on the side of the road where they might not be visible with the naked eye until it's too late.

Ω





# 1 Study at Home

We live in a constantly changing world, where exciting new technological advancements are made everyday. At the Cleveland Institute of Electronics we make it simple to train, earn a degree and prosper in the workforce. Over 150,000 students in the United States and 70 foreign countries got their start in electronics through CIE. And they received their education at their own pace in the comfort and convenience of their homes. At CIE you'll receive a first class education by a faculty and staff devoted to your career advancement. All of CIE course and degree programs are taught through a patented, proven learning process. To discover all the benefits and programs/ degrees available from CIE send for your free course catalog today.



CIE's Associate Degree program contains 397 lab experiments.

# 2 Work Where You Want

And once you complete your education at CIE, you can just about write your own ticket to where you want to work and in what specialized field... MIS, broadcasting, industrial, automotive, management... The opportunities seem limitless in today's high-tech world.

The Cleveland Institute of Electronics has been approved for use of Veterans Affairs Benefits and DANTES Tuition Reimbursement.

Tuition assistance from the Veterans Administration or the DANTES Program is available to veterans and service members in the Armed Forces.



Employees are seeking & hiring qualified applicants.

## FREE CATALOG



1776 E. 17th Street  
Cleveland, Ohio 44114-3679

Visit Our Web-Site  
[www.cie-wc.edu](http://www.cie-wc.edu)

☐ **YES!** I am interested.  
Please send me a catalog.

Name: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

Phone Number: \_\_\_\_\_

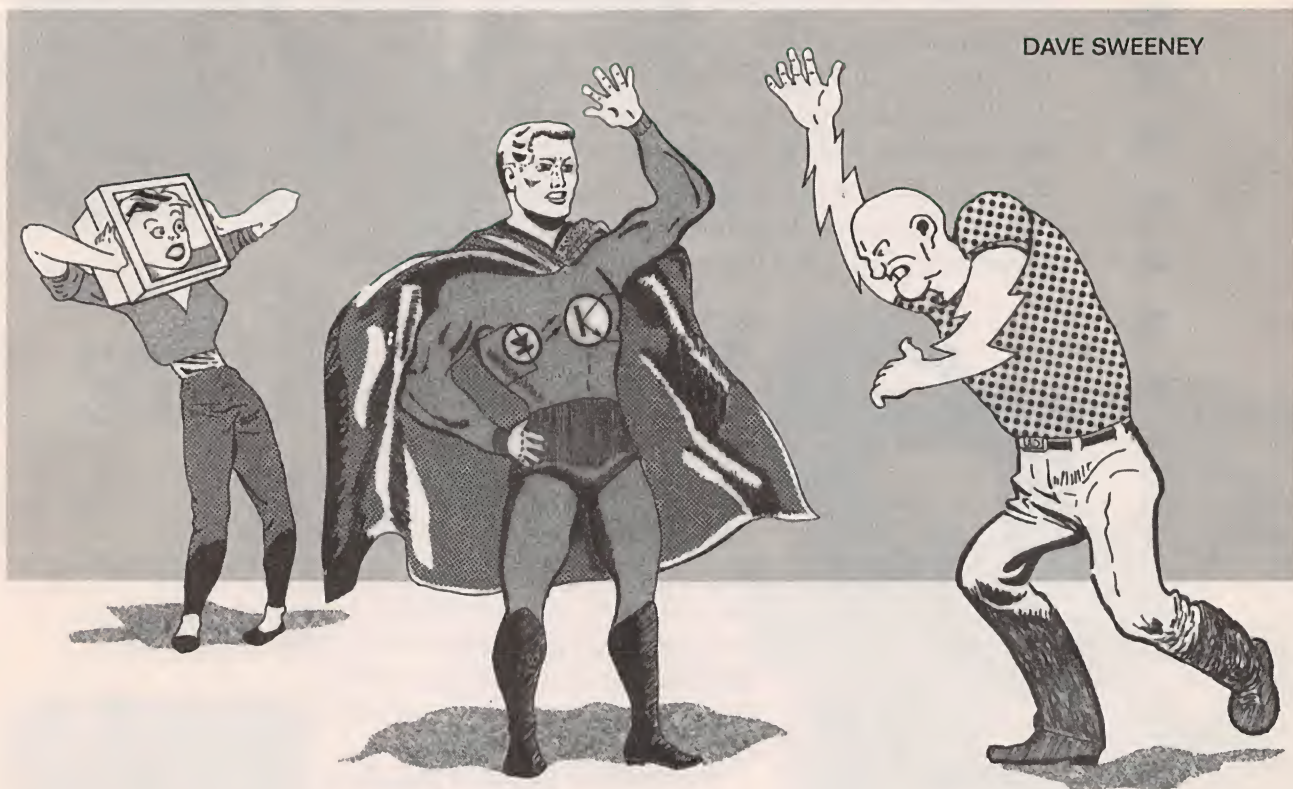
*A school of thousands. A class of one. Since 1934.*

AE144



# PROTECT YOUR COMPUTER'S PARALLEL PORT WITH THIS OPTICAL ISOLATOR

DAVE SWEENEY



*Accidentally burning out a computer's internal circuitry is a thing of the past with this simple device.*

There are an ever-increasing quantity of projects and devices that are controlled by the output signals available from a computer's printer port. Examples of those devices include relays, stepper motors, lights, and even electric trains. There have also been several projects that have appeared in both **Electronics Now** and our sister magazine, **Popular Electronics**. In fact, if a way can be found to use a 5-volt digital signal to control some device, it can be hooked up to a printer port and controlled by some simple software commands. With that ability at your fingertips, you could (dare we say it)...run the world!

Seriously, though, interfacing a computer to a piece of hardware and having the software react to feedback from external signals has opened up a new level of control and sophistication in electronics. The problem many times has become one of taking proper safety steps to safeguard your computer from any errors that you might have made in assembling your latest experimental project. The days where you could build a new project and "watch for smoke" are sadly (or thankfully) gone. An ungrounded soldering iron, voltage on a ground return, or a short at the wrong moment could zap a com-

puter's internal circuits. Even an inductive pulse on the computer's output could cause a smokeless tragedy.

What is needed then is a way to electrically isolate the printer port's signals yet let them pass through to the device that they are to control. The ideal solution is optical isolation. That way the parallel port's pins are disconnected electrically from the outside world, but signals can flow back and forth on a beam of light. Combining the Parallel-Port Optical Isolator presented here with software that controls the separate pins on the parallel port results in a system that's safe



for computer control of your experimental devices.

**Light Signals.** By using light to conduct a signal, optical isolators interrupt the electrical connection between their input pin and output pin. A typical arrangement, shown in Fig. 1, demonstrates the concept. Inside the optical isolator are a light-emitting diode and a phototransistor. When a positive voltage is applied to the LED through current-limiting resistor R1, the LED shines. The light from the LED falls on the phototransistor, causing it to conduct as if a current were applied to its (non-connected) base lead. Note that on some real-world optical isolators, the phototransistor's base lead is brought out to an additional pin.

Normally, the collector lead of the phototransistor is at a positive voltage supplied through R2. When the phototransistor conducts, the current through R2 is shunted to the output ground through the phototransistor's emitter. Because of the voltage drop inherent in all semiconductors, the voltage on the phototransistor's collector will generally be below one volt—it will never reach a zero-volt potential unless the emitter is connected to a negative voltage that is equal to the phototransistor's voltage drop.

At this point, the output signal is an inverted version of the input signal; if that is fine for your application, no further conditioning to the signal is needed. However, it is usually best to keep the polarity of the output and input signals matched. In the Fig. 1 example, the inverted and isolated signal is buffered and re-inverted by an op-amp. An additional advantage of using an op-amp is having a low-impedance output.

It is very important to note that the input and output grounds are not connected together in any way; the purpose of optical isolation would be defeated if they were. To further enhance electrical isolation, a separate power supply should be used for the output portion of the circuit; that is, the phototransistor and op-amp.

**Circuit Design.** The full schematic diagram for the Parallel-Port Optical Isolator is shown in Fig. 2. Note that it

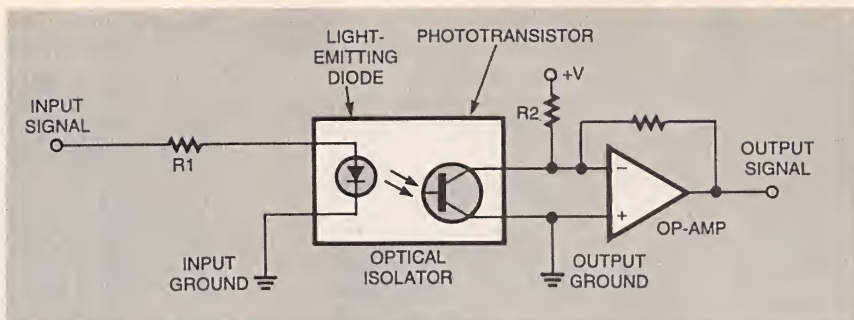


Fig. 1. A simple opto-isolator circuit can completely isolate input from output electrically without impeding the signal itself; the signal travels on a beam of light.

is very similar to the single isolation circuit of Fig. 1. While any opto-isolator chip that has a similar pinout can be used in place of the devices specified, keep in mind that the suggested units have an isolation rating of 5000 volts—much higher than most other units that are commonly available.

In our discussion of the basic circuit, we did not mention any detailed description of the op-amp. Traditionally, an op-amp in its linear mode always tries to keep its two input lines at the same voltage level. By feeding back the op-amp's output voltage to one of the inputs, the output can be made to follow an input signal at whatever ratio and pattern set by external components. While that explanation is very simplistic, it is sufficient for our purposes here; a detailed discussion can fill a book.

When used in a non-linear mode (linear mode with "infinite" gain), an op-amp compares the voltage levels of the inputs. If the non-inverting input is higher than the inverting

input, the output will go high. A reference voltage is needed to set the point at which the output will change state. A reference voltage of one-half the power supply voltage is created by R41 and R42; that reference voltage is applied to all of the non-inverting inputs. As long as the voltage from the phototransistors does not fluctuate beyond that level, the output of the op-amps will remain stable.

An additional opto-isolator, IC3, lets the Parallel-Port Optical Isolator send isolated feedback signals to the computer. Note that op-amp buffers are not used. Since the parallel-port input circuit is a known load that does not change, buffering is not necessary. However, note that the phototransistor's load resistor is connected between the emitter and ground, acting as a pull-down resistor when the phototransistor is off; the result is a non-inverting output to the computer. Although there are five input lines in a standard parallel port, only four are implemented; the opto-isolator chip that we are

#### LISTING 1

```

10          'Continuous pulse output to pin 3
OUT &H3BC,0 'Start
D=2         'Reset all pins - port 3BC is assumed. Port 278 or 378 possible
32=pin 7, 64=pin 8, 128=pin 9
PW=5       'Value selects pin - 1=pin 2, 2=pin 3, 4=pin 4, 8=pin 5, 16=pin 6,
           'Controls the time the output is high (pulse width)
OUT &H3BC, D 'Begin pulse generation
DO WHILE I,PW 'Sets pin 3 high
    I=I+1
LOOP
I=0
PI=10      'Controls the interval between pulses
OUT &H3BC,0
DO WHILE I<PI
    I=I+1
LOOP
GOTO 20

```



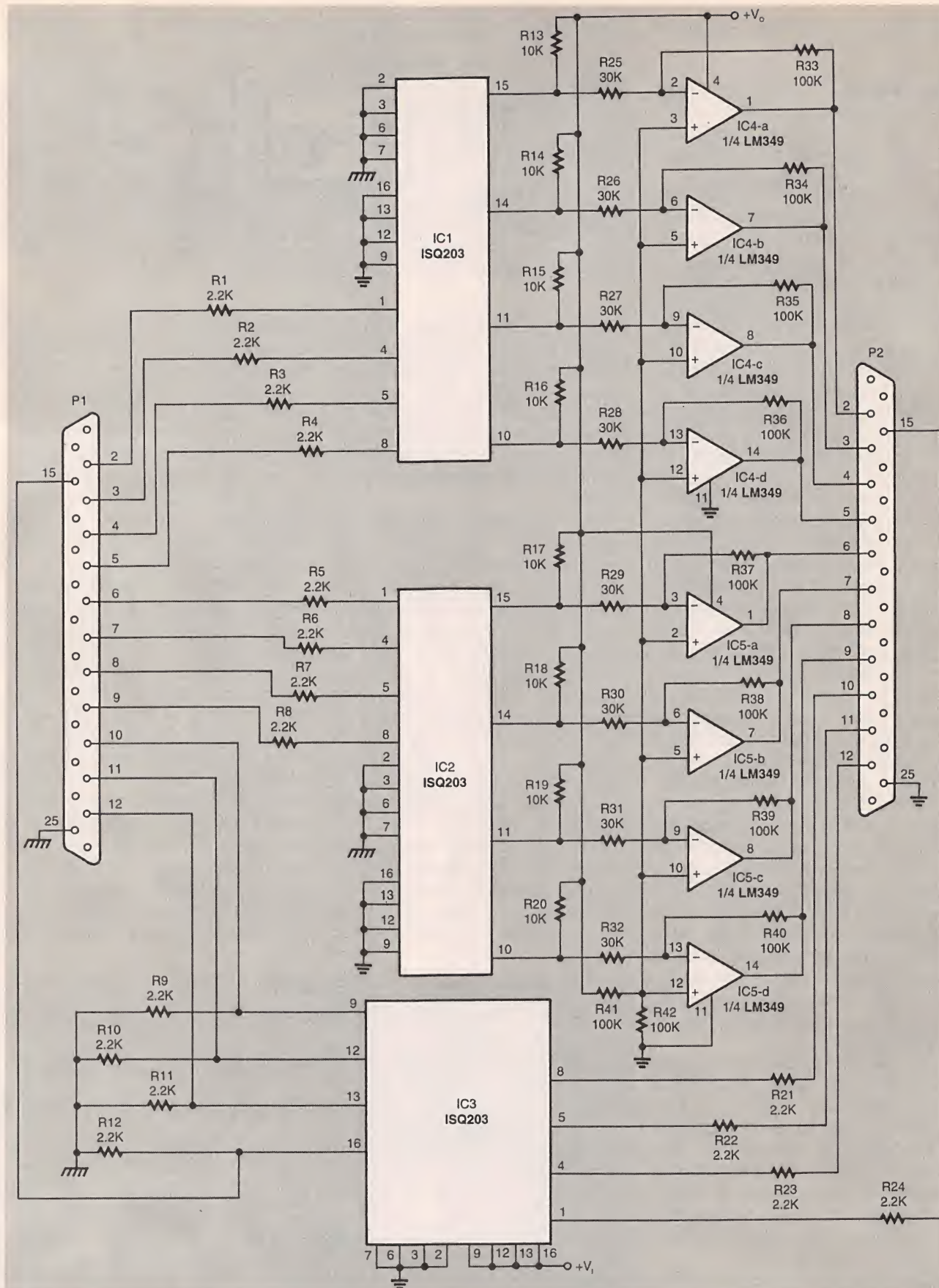


Fig. 2. The Parallel-Port Optical Isolator uses a series of eight opto-isolator circuits to isolate the port's output lines. An additional set of four circuits lets feedback signals enter the computer. Note that two completely separate grounds are used.



using has four isolation circuits. With those input signals, the computer software can react to signals from whatever external hardware is plugged into the Parallel-Port Optical Isolator. Similarly, only the eight main data lines are used for output. Since not all of the standard signals are connected, the Parallel-Port Optical Isolator can't be used with traditional computer equipment such as printers or other devices that plug into the parallel port. Those limitations should be kept in mind when you are connecting any type of hardware to the Parallel-Port Optical Isolator.

**Power Supply.** As mentioned above, the Parallel-Port Optical Isolator needs a separate power supply to prevent any possible electrical damage to the computer. The schematic for the power supply is shown in Fig. 3. Each supply voltage is regulated. While IC6, a simple 5-volt regulator supplies power to the input circuit (IC3), a higher voltage is needed for the output (computer-to-hardware) circuit. In order for the op-amps to achieve a 5-volt peak output, their supply voltage must be at about 6.5 volts. An LM317T adjustable regulator is used for IC7.

With a 12-volt input, the values shown for R1 and R2 will set the output to 6.5 volts. Variations in the supply voltage might change IC7's output voltage; adjusting the value of R2 will compensate for any supply variations.

**Construction.** The Parallel-Port Optical Isolator is simple enough to be built on a piece of perfboard using standard construction techniques. However, a neater assembly results if a PC board is used. For those that would like to use the printed-circuit approach, foil patterns for the single-sided boards have been provided. Note that the power-supply regulators have been placed on a separate board. Having two smaller boards instead of one large one gives you more flexibility in choosing a suitable enclosure for the unit.

If you decide to etch your own PC boards using the foil patterns, follow the parts-placement diagrams when assembling the boards; Fig. 4 is for the optical-isolator circuit itself while Fig. 5 is for the power-supply regulators.

It is a good idea to use sockets for the integrated circuits. Not only will that make it easier to replace a "zapped" IC when repairing the unit,

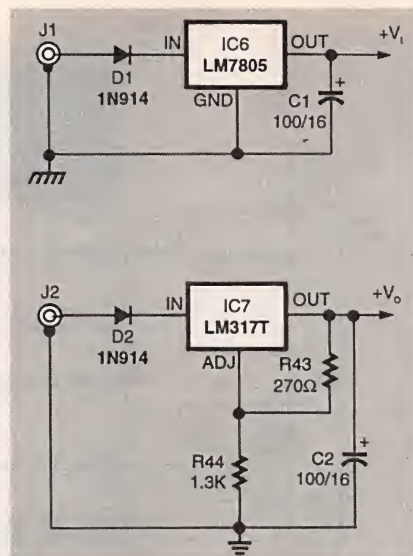
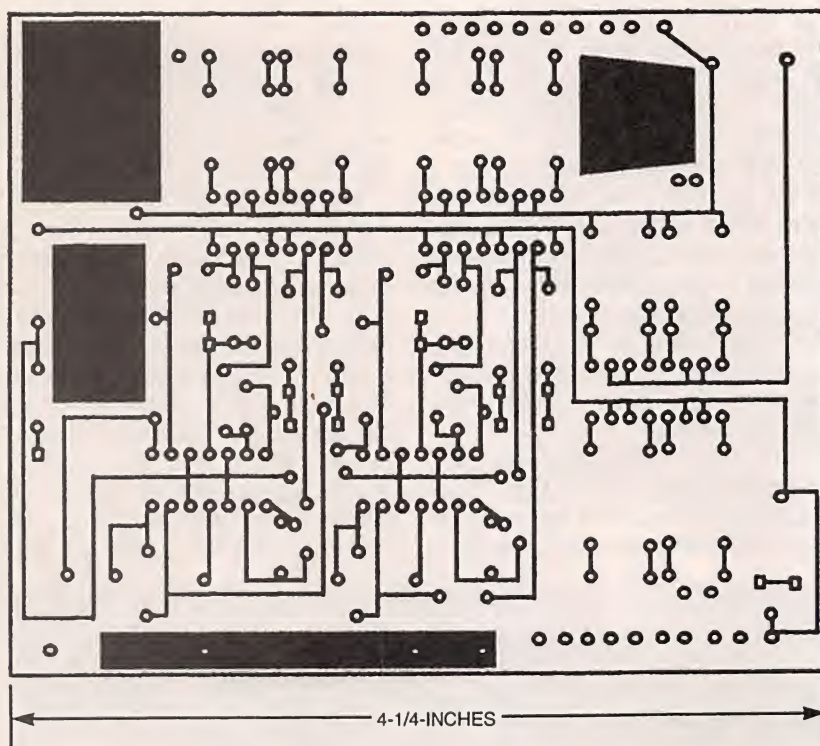


Fig. 3. A simple pair of power regulators supply the Parallel-Port Optical Isolator. Note that the output supply uses an LM317T to supply 6.5 volts to the op-amps. That way, the output of the op-amps can reach a full five volts for CMOS compatibility.

It will make testing easier. For now, just install the sockets; do not install the ICs at this time. When building the main board, don't forget to install the several jumpers that are indicated; use insulated wire to prevent any accidental shorts.

**A Ready-Made Enclosure.** The Parallel-Port Optical Isolator can be housed in any suitable enclosure. However, cutting the trapezoid-shaped holes for the DB-25 connectors can be difficult. It would also become annoying having to keep plugging and unplugging the Parallel-Port Optical Isolator every time you wanted to use it. The solution to those problems is to install the unit into an existing parallel-port A-B switch. Those devices, available at most computer stores, let you connect two pieces of equipment to a parallel port. By turning the switch on its front panel, you can connect either device to the computer without having to change or move any cables, saving wear and tear on the connectors, pins, cables, wires, and—most importantly—your sanity!

In selecting an A-B switch, it is important to choose a mechanical one. There are "automatic" devices available, but they are completely electrical in nature and sometimes require special software to use.



Here's the foil pattern for the Parallel-Port Optical Isolator's main board.



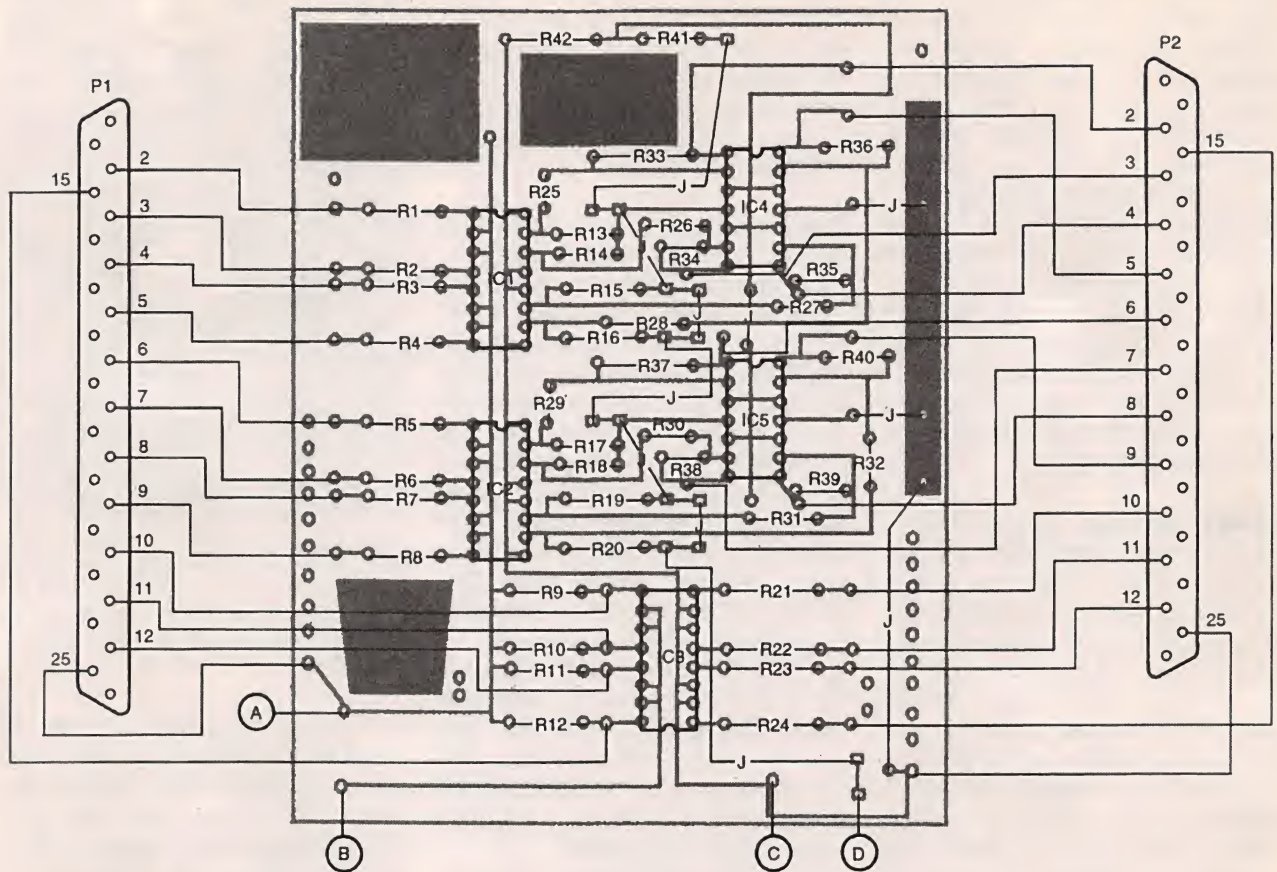


Fig. 4. The Parallel-Port Optical Isolator uses a single-sided PC board. Note that several jumpers are needed to complete some connections. Some of the resistors might be a tight fit for flat mounting and might have to be mounted vertically.

Another important feature to look for is that the A-B switch uses individual wires to make the connections between the connectors instead of a PC board. While the PC-board version is considered a "deluxe" model that minimizes crosstalk between the signals, the modification of the wire-type switch is much easier.

The author's prototype was installed in such a box; it can be seen in Fig. 6. Note how the main PC board sits at the bottom of the case while the power-supply board is tucked against the front panel next to the switch.

Start by removing the switch and the connectors from the case without breaking any of the wires. Select one of the "output" connectors for optical isolation; don't use the "common" connector that will go to the computer. Cut each wire between that connector and the switch, strip the two ends, and install them into

the appropriate holes on the main PC board. The wire from the switch goes to the Parallel-Port Optical Isolator's connections for P1, while the wire from the DB-25 socket is wired up as P2. The PC board has extra solder pads for the wires that are not used. Connecting them will prevent any loose wire ends from rattling around in the enclosure. If you don't want to make all of those extra connections, the wires can be simply removed by unsoldering or simply clipping them off.

Note that there are several connections labeled "A" through "D" in Figs. 4 and 5. Those are the connections between the main board and

the power-supply board. When making the connections for J1 and J2, the connectors can be substituted with direct connections between the PC board and the transformers. In that case, a suitably sized hole ( $\frac{3}{8}$ -inch is a good choice) should be drilled in the back of the case. Mount a rubber grommet in the hole and run the transformer wires through the grommet before soldering them to the power-supply board. Be sure to tie an overhand knot in the wires before soldering them to act as a strain relief. The obvious disadvantage to that arrangement is the heavy transformers that are permanently tethered to the unit, mak-

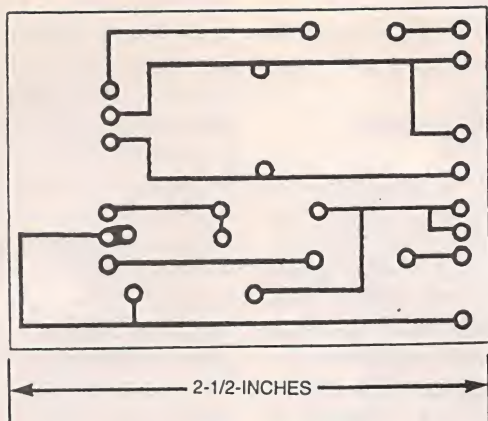
#### LISTING 2

'Input sensing

```
10
DATA%=0
DATA%=INP(&H3BD)
PRINT DATA%
GOTO 10
```

```
'Initialize a variable
'Read state of input pins
'Display value of pin reading
```





Here's the foil pattern for the Parallel-Port Optical Isolator's power-supply board.

ing it difficult to move the Parallel-Port Optical Isolator from one location to another.

Install the main PC board in the bottom of the case. Be sure to insulate the bottom of the box to prevent shorts; a piece of heavy gray "fish" paper, electrical tape, or gasket paper will work well. If you don't want to drill holes for screws, nuts, and spacers, you can bond a few pieces of hook-and-loop fastener material to the bottom of the PC boards and to the insulating paper. If

and output connectors; pin 1 to pin 1, pin 1 to pin 2, pin 1 to pin 3, and so on. Once all 25 combinations have been checked, continue with pin 2 to pin 1, pin 2 to pin 2, pin 2 to pin 3, and so on.

On the same connector, pins 2 through 9 should read infinity to ground (pin 25). On the input connector (P1), pins 10-12 and 15 should read 2200 ohms to ground; on the optically-isolated connector, they should all read infinity to ground. Be sure to use pin 25 of the

read between 5 and 7 volts. On IC4 and IC5, pins 3, 5, 10, and 12 should read about 2.5 volts.

Unplug the transformers and insert the ICs. With the power turned on, apply pulses from a pulse generator to the input pins and check to see that the pulse appears on the corresponding pin on the other connector. Pins 2-9 pass signals from P1 to P2, while pins 10-12 and 15 go in the opposite direction. If you don't have a pulse generator to test the unit, the QBASIC code shown in Listing 1 can be used for testing the output pins. The comments in the program are self-explanatory. Monitor the pins on P2 with an oscilloscope and verify that the pulse rises to 5 volts and that there is no crosstalk between pins. The program will have to be modified to check each output pin in turn. Don't forget to choose the port address for the parallel port that the Parallel-Port Optical Isolator is plugged into. The example program is set for hexadecimal value 3BC; the other valid combinations on IBM compatible computers are 278 and 378 (again, in hexadecimal values). If you are unsure of the address of your port, you should check your computer's manual. If you have Windows95 or Windows98 installed on your machine, port addresses can be found in Device Manager, which can be found in the System Properties tool in Control Panel. If you are at an MS-DOS prompt, the utility MSD (Microsoft Diagnostics) can tell you the address of the parallel ports that are installed in your machine. Again, consult your computer's documentation if you are unsure how to go about doing that.

The simple program in Listing 2 can be used to check the input pins. As you apply a positive voltage to one input pin at a time, you'll see the value on the screen change. Again, check that there is no crosstalk between pins. Also note that the input port is one value higher than the address used in Listing 1. In the published examples, the output port is 3BC; the companion input port is 3BD. If you are using one of the other values, the input address would be x79 depending on which address your computer's parallel port is set for.

Once the Parallel-Port Optical

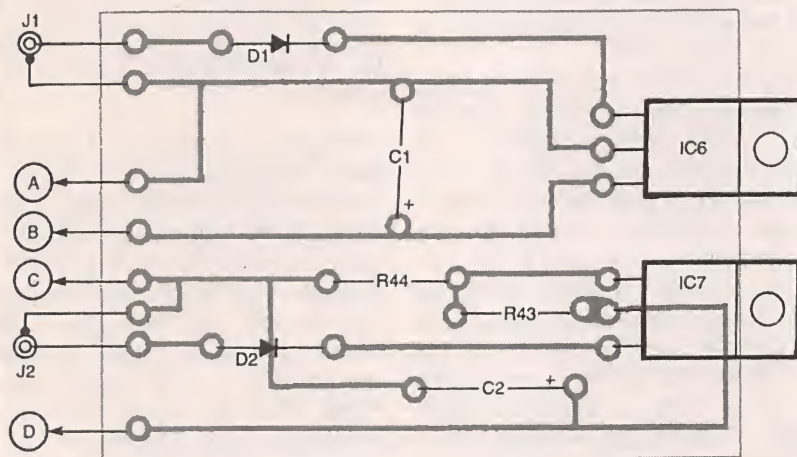


Fig. 5. The power-supply board is a simple single-sided construction. The four connections labeled "A" through "D" show the connections between the power-supply board and the main board.

you decide to go that route, be sure to glue the insulator to the case!

**Testing.** With no ICs installed, turn the switch to connect to the optically-isolated connector. Measure for infinite resistance on all combinations of pins between the input

same connector as your ground reference when making those checks. You should also read infinite resistance between the two power supplies and the two grounds.

Plug in the transformers. On IC1-IC3, pins 10, 11, 14, and 15 as well as pin 4 on IC4 and IC5 should



Isolator is verified as working without errors, it can be closed up and put to use.

**Using the Parallel-Port Optical Isolator.** If you know how to write your own software in your favorite language, you might already be familiar how to send and receive data from the parallel port. If not, QBASIC provides an extensive array of commands for building your own port-control software to switch port connector pins high or low. Keep in mind that since we are not using the Parallel-Port Optical Isolator to control a printer, the published standards that assign specific functions to each of the pins will not apply.

If you are going to be using QBASIC, a modified version of the test programs shown in Listings 1 and 2 can be used as simple subroutines. Those subroutines can be used in any program that you write whenever they are needed. Let's take a closer look at the two statements that the programming examples are built around: the "OUT" and "INP" statements.

### PARTS LIST FOR THE PARALLEL PORT OPTICAL ISOLATOR

#### SEMICONDUCTORS

IC1-IC3—ISQ203 Quad opto-isolator, integrated circuit (Jameco 114083 or similar)  
IC4, IC5—LM349 Quad op-amp, integrated circuit  
IC6—LM7805 voltage regulator, integrated circuit  
IC7—LM317T adjustable voltage regulator, integrated circuit  
D1, D2—1N914 silicon diode

#### RESISTORS

(All resistors are 1/4-watt, 5% units.)  
R1-R12, R21-R24—2200-ohm  
R13-R20—10,000-ohm  
R25-R32—30,000-ohm  
R33-R42—100,000-ohm  
R43—270-ohm  
R44—1300-ohm

#### ADDITIONAL PARTS AND MATERIALS

C1, C2—100- $\mu$ F, 16-WVDC, electrolytic capacitor  
J1, J2—Co-axial power connector  
P1, P2—DB25 subminiature connector  
12-volt DC power adapters, case or existing A-B port switch, hardware, wire, etc.

**The "OUT" Statement.** The OUT command sends a byte to a port; The OUT statement has the format

OUT <port>, <data>

where <port> is an address and <data> is a number in the range 0-255. In the Listing 1 test program, note that the address is being specified in hexadecimal rather than plain decimal. The choice is one of personal preference; whatever format you choose should be consistent across all of your software for readability's sake. We've already discussed what address to use to access the parallel port; you should already know that number at this point. The value for <data> can be a variable that is set by some other part of the program, the result of an INPUT statement (that will be discussed later), or even a constant number. Converting a decimal to binary will indicate which pins on the parallel port will be set high. The decimal values of the output pins are listed in the comments of Listing 1. Any output pin that is not addressed will automatically be set low by the OUT statement. The combination of high and low settings on the port pins will remain until another OUT statement addresses the port and changes the values of the port.

If you want to generate a series of timed pulses or a single pulse on the parallel port, consecutive OUT statements must have timing loops between them to set the amount of delay between turning the pins on and off (as was done in the program in Listing 1). Keep in mind that any simple delay loops, especially in QBASIC, will depend on the speed of the computer's central processor. Other solutions are available in more sophisticated programming languages such as Visual Basic, C++, and Turbo Pascal to name just a few. The use of those program-development packages are beyond the scope of this article and is left up to the reader's personal preferences.

**The "INP" Function.** The INP function returns a decimal value between 0 and 255 that is read from a port. The values that are returned from the Parallel-Port

Optical Isolator's input pins will have to be determined by simple experimentation. Once they are known, the signals can be read and acted upon at one time or the individual bits can be separated out and examined one at a time.

Since INP is a function and not a command by itself, a destination for the read data must be specified. A variable is the usual way to use the function. Once the data is read in, the variable can be examined and the appropriate action taken. Another technique is to use the INP function as a part of an IF...THEN statement. However, it would become quite cumbersome to mask out the bits that you aren't



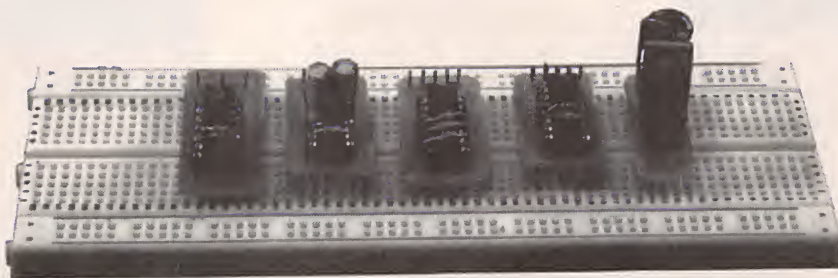
Fig. 6. The Parallel-Port Optical Isolator fits neatly into the bottom of a computer A-B switch. Note that the author's prototype, shown here, has the power transformers hard-wired to the supply board.

interested in with a single statement. Additionally, if you want to have several branches depending on the state of the input pins, you'd have to read the input port each time you wanted to test for a possible branch. For example, if you want to have three possible branches in your program, you'd need three IF...THEN statements. There is also the possibility that the port value might change between readings for the various IF...THEN statements. Again, more sophisticated programming languages have many different approaches.

With the Parallel-Port Optical Isolator attached to your computer, you can experiment with controlling hardware without the fear of what a simple error could do to your computer. The worry of an expensive computer going "up in smoke" is a thing of the past!  $\Omega$



# The BreadBlox Prototyping System



*Stop "re-inventing the wheel" whenever you breadboard a new circuit with these handy modules!*

JAMES MELTON

**T**he solderless breadboard is without a doubt one of the best ideas that anyone ever had. Simple in concept, as most truly good ideas are, the solderless breadboard lets you try out a new circuit idea or integrated circuit as fast as you can make connections between components.

Of course, not all is perfect. If you have used a breadboard for any length of time, you know that that technique's disadvantages are:

- It is easy to make wiring errors you must make sure each component makes good contact
- You must keep an eye out for loose or 'knocked over' components
- It is boring and tedious to wire the same support circuits again and again

If there were one way that the breadboard could be made even easier to use, it would have to do with that last point. It has been the author's experience that when evaluating a new chip, there are many subassemblies (referred to in the electronics industry as "glue logic") that are needed to connect a circuit to the outside world.

Since many of those basic "glue logic" circuits are used over and

over again, doesn't it make sense to build those circuits on small PC boards, then add some pins so that the boards can be plugged into a solderless breadboard? Well, the BreadBlox system presented here does just that.

Whatever you're building, one or more of the five BreadBlox presented here are sure to be handy. They are a clock generator, a tone decoder, an inverting op-amp, a non-inverting op-amp, and a voltage regulator. Let's look at each of them.

**The Clock Generator.** Figure 1 is the schematic diagram for the clock generator. It is built around IC1, an LM555 timer running in its astable mode. The circuit needs only three connections to the breadboard—power (between 5 and 15 volts), ground, and output. The astable mode of a 555 provides a constant-frequency squarewave based on the values of R1, R2, and C1. The formula is:

$$F_{OUT} = ((R1 + R2) \times C1 \times 1.1)$$

The output of the 555 timer will source or sink up to about 200 mA.

While the 555's output is TTL compatible with respect to voltage levels, keep in mind that those levels will change as the current load is increased. For example, with a supply voltage of 15 volts and a 200-mA load, the highest voltage a 555 can put out under those conditions is only 12.5 volts. Be sure to review the specification sheet for the chip before attempting to "push the envelope."

**The Tone Decoder.** The tone decoder (see Fig. 2) uses an LM567 for frequency detection. That chip contains an oscillator and phase detector that together work as a phase-locked loop circuit. The circuit needs four connections to the solderless breadboard—power, ground, the input signal, and "tone detected" output. The LM567 can use a supply voltage between 4.75 and 9 volts. By choosing the values of R3 and the three capacitors, a combination of center frequency and bandwidth can be set.

The center frequency is set with R3 and C2; C4 sets the detection bandwidth. Formulas and detailed information on those calculations, as well as test and application circuits are published in the LM567's data sheet. That information, as well as specifications of their entire



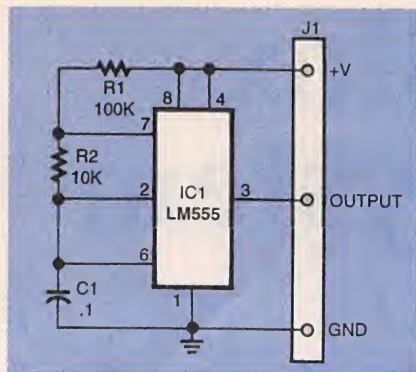


Fig. 1. A clock generator built around an LM555 is a handy BreadBlox. The frequency can be adjusted to suit, and the output can be both TTL and CMOS compatible.

product line, is available for download at National Semiconductor's Web site (<http://www.national.com/pf/LM/LM567.html>).

The output of IC2 is an open-collector arrangement. That means that you need to use a pull-up resistor for a valid voltage to appear. That arrangement makes the output compatible with any type of logic family. Limit the current drawn from the output to about 10 mA. Be ready to have long (greater than several seconds) detect times at lower frequencies.

**The Op-Amps.** The operational amplifier is among the most widely used analog circuits; two versions have been included with the BreadBlox. An inverting op-amp circuit is shown in Fig. 3, while a non-inverting circuit is shown in Fig. 4. Although the two circuits are very similar, there are minor differences between them. Both have a feed-

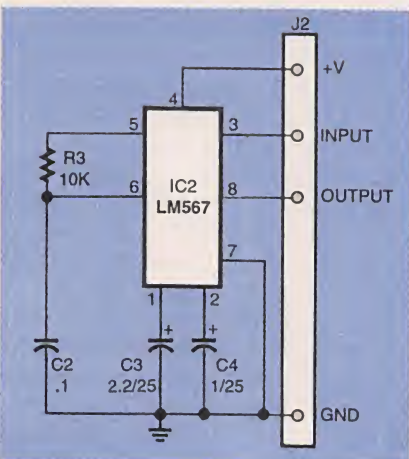


Fig. 2. A tone-decoder BreadBlox might be useful as a piece of test equipment as well as a part of an experimental circuit.

back resistor (R4 or R7) plus an input resistor (R5 or R8) on the inverting input. The values of those two resistors set the gain for the op-amp circuit. In the inverting circuit, the gain is given by the formula:

$$V_{OUT} = -V_{IN}(R2/R1)$$

For the non-inverting amplifier, it is:

$$V_{OUT} = V_{IN} \times (1 + (R2/R1))$$

Note that an op-amp can lower or raise the input voltage depending on the values of R4/R5 or R7/R8. Many op-amp circuits omit R6 (as we've done on the non-inverting circuit), but if you are dealing with circuits that are intended to pass

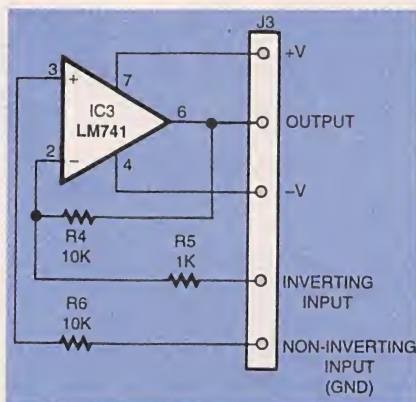


Fig. 3. An inverting op-amp is one of the staples of analog circuit design.

DC voltages at very accurate levels, it is best to include that resistor. If you want to simplify your circuit, you can replace R6 with a jumper wire; test your circuit to see if it will perform as needed.

Both op-amp circuits need a bipolar (positive and negative) power supply; the LM741 requires both voltages. A nice feature of op-amps in general is that you can substitute many other types for the LM741—nearly all single op-amps have the same pinouts.

**The Voltage Regulator.** To round out our collection of BreadBlox, we've included a three-terminal regulator; the schematic is shown in Fig. 5. While a standard 7805 5-volt regulator is shown, other types can be substituted for whatever voltage is needed. For example, many of the newer chips require lower voltages

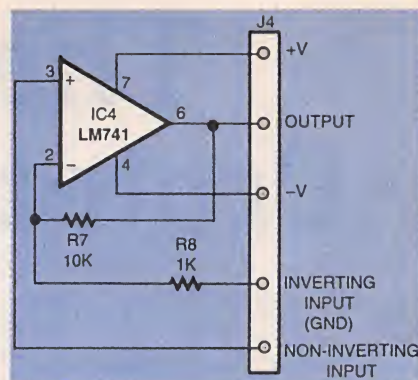


Fig. 4. A non-inverting op-amp makes a handy impedance-matching circuit. The gain can easily be changed by substituting different resistor values.

than even the 5 volts that is standard on most breadboards; 3.3 volts and even lower voltages are often needed for microprocessor or digital-signal-processing chips. With a BreadBlox voltage regulator, you can use the existing power supply on your breadboard without taking up too much space. The capacitor selection depends somewhat on the input voltage, the load, and the input ripple. If you are reducing a voltage that is already filtered, such as producing a 5-volt output from a 12-volt supply, you might not need C5. Do not eliminate C6. Under most conditions, a high-frequency and high-amplitude noise or ripple will be the result.

**Construction.** The BreadBlox should be built on a PC board to best stand up to repeated handling and similar "abuse". A foil pattern for a single-sided board has been included here. Note that all five BreadBlox are included on the

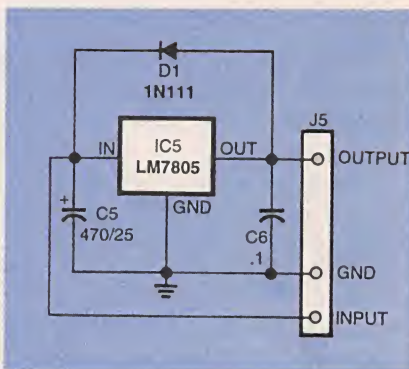


Fig. 5. While some powered breadboards might have a 5-volt supply, this BreadBlox can be used for any voltage—positive or negative—simply by changing IC5. If you want to make a negative-regulator module, pay attention to the IC pinouts as well as the polarity of C5.



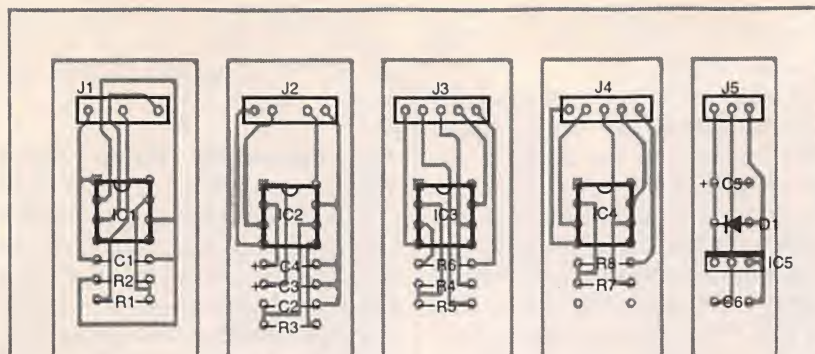


Fig. 6. With the exception of the voltage regulator, all of the BreadBlox components are inserted into machine-pin IC sockets—making them a miniature breadboard in their own right!

one pattern; it is much easier to etch one large board than five tiny boards. As an alternative, an etched PC board is available from the source given in the Parts List. If you decide to make your own boards, be sure to use a high-quality fiberglass board such as FR-4 for a stronger assembly.

After etching and drilling the boards, use a bandsaw or a pair of heavy tin snips to cut them apart. After the five modules have been separated, use a belt sander, a sheet of emery cloth, or 100-grit sandpaper to sand the boards down as far as possible. The goal is to make the boards as small as possible without damaging any of their copper traces!

Follow the parts-placement diagram in Fig. 6 for locating the various components. A good place to start is with J1–J5. Those connectors, used to make all of the connections between the BreadBlox and the solderless breadboard, are made from wire-wrap pins. The

holes in the board should be drilled just undersized for those pins; a special technique is needed to push the pins through the holes. Clamp the PC board in a vise and hold the pin near its top with a pair of needlenose pliers. Heat the tip of the pin with a 50-watt soldering iron and begin pushing it into the board. The PC-board fiberglass will begin to melt and deform. Slowly push the pin into the board while keeping it hot until it is fully seated. Let the pin cool—the melted board material will solidify around the pin. The resulting tight fit will help give the pin a better mechanical connection to the board, so it will hold up while you are inserting and removing the BreadBlox from your breadboard. It is a good idea to put all of the wire-wrap pins into all of the modules at one time while you are set up to do so.

All of the modules, with the exception of the voltage regulator, get an IC socket that has machined or “colletted” pins—do

## PARTS LIST FOR THE BREADBLOX

### SEMICONDUCTORS

IC1—LM555 timer, integrated circuit  
IC2—LM567 tone decoder, integrated circuit  
IC3, IC4—LM741 op-amp, integrated circuit  
IC5—LM7805 voltage regulator, integrated circuit  
D1—1N111 germanium diode (NTE109 or similar)

### RESISTORS

(All resistors are  $\frac{1}{8}$ -watt, 5% units.)  
R1—100,000-ohm  
R2–R4, R6, R7—10,000-ohm  
R5, R8—1000-ohm

### CAPACITORS

C1, C2, C6—0.1- $\mu$ F, ceramic-disc  
C3—2.2- $\mu$ F, 25-WVDC, electrolytic  
C4—1- $\mu$ F, 25-WVDC, electrolytic  
C5—470- $\mu$ F, 25-WVDC, electrolytic

### ADDITIONAL PARTS AND MATERIALS

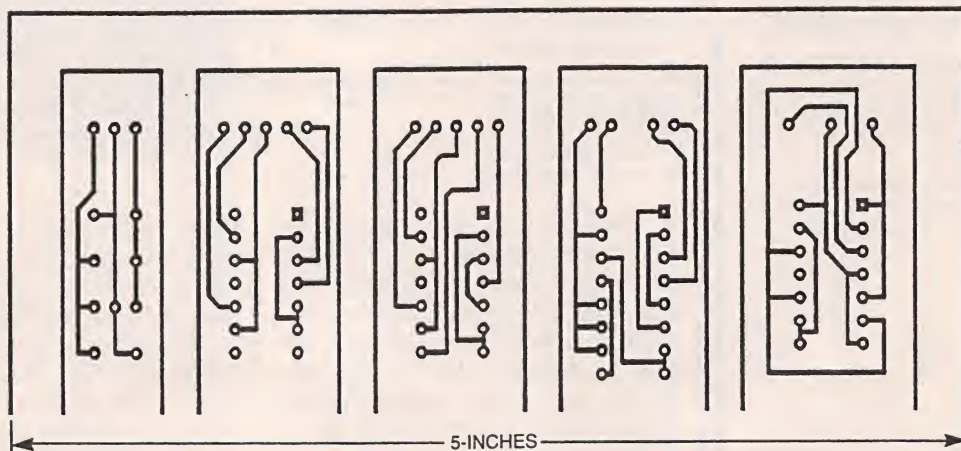
J1–J5—Wire-wrap pins (Vector T-44 or similar)

Machined-pin IC sockets

**Note:** The following item is available from James Melton, 2747 Wentworth Drive, Grand Prairie, TX 75052: PC board and wire-wrap pins, \$16.99 plus \$3.00 shipping and handling. Texas residents must add appropriate sales tax. No COD orders will be accepted.

not use the low-cost wiper-contact sockets. The colletted pins will let you use the BreadBlox as miniature breadboards, making it easy to substitute different resistors and capacitors to change the circuit characteristics of the individual modules. A high-quality socket will also withstand repeated insertions and removals of components.

After installing the wire wrap pins



Here's the foil pattern for the BreadBlox. All of the modules can be made at one time with this single-sided pattern.



# You can Build Gadgets! Here are 3 reasons why!

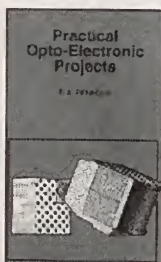


## ☐ BP345—GETTING STARTED IN PRACTICAL ELECTRONICS .....\$6.99

If you are looking into launching an exciting hobby activity, this text provides minimum essentials for the builder and 30 easy-to-build fun projects every experimenter should toy with. Printed-circuit board designs are included to give your project a professional appearance.

## ☐ BP349—PRACTICAL OPTO-ELECTRONIC PROJECTS .....\$6.99

If you shun opto-electronic projects for lack of knowledge, this is the book for you. A bit of introductory theory comes first and then a number of practical projects which utilize a range of opto devices, from a filament bulb to modern infrared sensors and emitters—all are easy to build.



## ☐ BP363—PRACTICAL ELECTRONIC MUSIC PROJECTS .....\$6.99

The text contains a goodly number of practical music projects most often requested by musicians. All the projects are relatively low-in-cost to build

and all use standard, readily available components that you can buy. The project categories are guitar, general music and MIDI.

Mail to:

**Electronic Technology Today, Inc.**

**P.O. Box 240**

**Massapequa Park, NY 11762-0240**

**Shipping Charges in USA & Canada**

\$0.01 to \$5.00.....\$2.00	\$30.01 to \$40.00.....\$6.00
\$5.01 to \$10.00.....\$3.00	\$40.01 to \$50.00.....\$7.00
\$10.01 to \$20.00.....\$4.00	\$50.01 and above.....\$8.50
\$20.01 to \$30.00.....\$5.00	

Sorry, no orders accepted outside of USA and Canada. All payments must be in U.S. funds only.

☐ Number of books ordered.

Total price of books.....\$	
Shipping (see chart).....\$	
Subtotal.....\$	
Sales Tax (NYS only).....\$	
Total enclosed.....\$	

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

Please allow 6-8 weeks for delivery. **ET03**

and the IC sockets, you are ready to insert the components and test your BreadBlox.

A 7800-series voltage regulator has leads that are slightly larger than the holes in the board. If you are using that type of regulator on the voltage-regulator module, the leads will have to be cut with a pair of diagonal cutters so that they will fit into the holes in the board. That will give the 7800-series regulator a better mechanical fit to the board. Invariably the regulator will be grabbed when removing the regulator module from the breadboard, so that component can use all the help it can get!

You'll find the BreadBlox are as handy to have in your experimenter's box as they are fun to use. After using them once or twice, you'll probably wonder how you ever got along without them.

The BreadBlox can also be of benefit to instructors in high school vocational programs, trade schools, and college labs. Not only can the BreadBlox be used to teach soldering skills to beginning students, they can then be used while the students begin learning simple circuits.

Note that we've just scratched the surface in this article. Every builder has favorite circuit sub-assemblies that he or she uses repeatedly. There is no reason that any of them can't be successfully implemented as a BreadBlox module. Please feel free to send any ideas that you might have for future modules to the author; the most popular ideas might be translated into a next-generation BreadBlox. Send your ideas to [melton@startext.net](mailto:melton@startext.net). **Ω**

## PIRATE RADIO

(continued from page 30)

However, because of the recent FCC raids, one European pirate, SWRS (Shortwave Relay Service) is currently heard in North America more than most of the stations from this continent. SWRS relays programs from many different pirates on 21,450, 11,470, and 7,490 kHz on most weekends. In the East, 21,450 kHz often fades in for a little while

from 1200-1400 UTC. 11470 can be heard for longer amounts of time, but with a weaker signal, and 7490 is rarely heard.

## The Future Of Pirate Radio.

Whether you call it "pirate" radio, "microbroadcasting," or "LPFM," unlicensed broadcasting has existed since the earliest days of radio. For years, people have speculated that the diversity of the commercial stations would eliminate pirate broadcasting. Instead, licensed

## What Do I Need To Hear Pirates?

Hearing shortwave pirates does require some specialized listening equipment, but you don't need a wall of equipment that could give NASA a run for its money. Of course, the first requirement is a shortwave receiver. The receiver doesn't have to be the latest in Stealth technology, but it must be more sensitive than the "boom boxes" that include shortwave bands. Typically, any receiver that is capable of tuning in SSB (single side-band) signals will tune in at least half of the pirates broadcasting in North America.

SSB reception is important because most pirates from this continent broadcast in the USB mode. Some of the portables that do well for receiving pirates include the Sony 7600 and 2010, Grundig YB-400, Sangean ATS-909, and the Drake SW-8. Also, any tabletop model should do quite well for receiving pirates.

You don't need a massive log-periodic or rhombic antenna on a few acres to hear pirates, but an external antenna certainly will help. On tabletop receivers, the antenna should be at least 20 feet long (although a longer antenna or a dipole will help). Anywhere from 10 to 40 feet of wire stretched out, with one end stripped and wrapped around the whip antenna of portables, will considerably raise the signal levels. Be aware that long antennas could cause damage to portable receivers, such as the Sony 2010.

Finally, a cassette recorder is helpful so that you can record programs for posterity. A notebook will help you to log all of the stations that you hear.

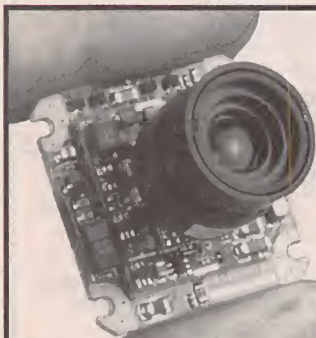
radio (both public and commercial) has become more homogenized. As more people are compelled to support the pirates, the FCC is stepping up its enforcement. Unless the FCC begins to implement unlicensed broadcasting bands, the pirate radio conflict will continue to make headlines across the country. Stay tuned. **Ω**



# Electronic SHOPPER<sup>®</sup>

SUPPLEMENT TO ELECTRONICS NOW JUNE 1999

## Micro Video Camera Sale



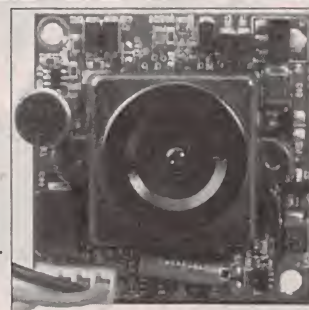
**MB-45cB**  
Color Video Camera  
2.8mm Lens  
45° Angle of View  
**\$99.95**

Size: 1.25" sq.



**MB-650Ua**  
Black & White Video  
Camera with Built-In  
Audio & 4.3 mm Lens.  
**\$89.95**

Size: 1.18" sq.



## Wireless Cameras

Wireless Camera Package Deals, include: one camera, one receiver and power supplies. (Receiver holds up to 4 cameras)

### Wireless 4-Channel A/V Black/White & Color Cameras



Built-in Mic  
(on All models)  
Cameras are shipped with 4.3mm lens.  
(Camera shown with optional lens.)

**GFS-1001 (900MHz)**  
**GFS-2002 (1.2Ghz)**

### Wireless Transmitter & Receiver

**2.4 GHz**

Video/Stereo Audio

**ONLY \$219.95**



Dimensions: 2.5"(W) x 2.18"(H) x 3.28"(D)

## Worlds Smallest Video Camera

No Bigger than the  
size of a Quarter!  
with CMOS Technology.

CM-550U - \$69.95  
Pinhole Camera Available:  
CM-550P - \$69.95

**240 Line Horizontal Resolution**  
Size: 1.12"(L) .5"(W)



## Micro Audio Receiver



• Audio Jack - RCA Female  
• Power Jack - 2.1 Female Barrel Jack

**MIC-300 - \$39.95**

## Video Conferencing

TeleEye has everything you need to do Color Video Conferencing. It comes with a built-in high quality digital camera, a high speed modem and state-of-the-art Audio/Video hardware.

**Remote View Window**  
Up to 15 frames per second  
or VHS-quality resolution.

**On-Screen Menus**  
Easy Control using your  
phone keypad.

**\$499.<sup>95</sup>**  
**Stand Alone System**  
**No PC Needed.**



**FREE**  
Polaris Product Catalogs

**LP-850p**  
**\$139.95**



Length: 1.37"  
Diameter: .87"

**Outdoor  
Model  
Available  
\$169.95**

**LP-850i**  
**\$129.95**

Length: 1.9"  
Diameter: .91"



**Polaris Industries**  
<http://www.polarisusa.com>  
**800.752.3571**

Polaris Industries 470 Armour Dr. Atlanta GA 30324 Tech Info: 404.872.0722 FAX: 404.872.1038



**SCO-1 - \$399.95**  
**Observation System**

## Interfaces with existing Camera Systems!

**System includes:**

- Monitor
- Camera/100 ft. Cable
- Camera Stand/Mount
- 2-way Intercom Station
- 100 ft. Intercom Cable
- VCR Interconnect Cable
- One Year Warranty

**SCO-1 - \$399.95**  
**Observation System**

June 1999, Electronics Now



# EARN MORE MONEY!

## Be an FCC LICENSED ELECTRONIC TECHNICIAN!



No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radio-telephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radio-TV, Microwave, Maritime, Radar, Avionics and more...even start your own business! You don't need a college degree to qualify, but you do need an FCC License.

**No Need to Quit Your Job or Go To School**  
This proven course is easy, fast and low cost! **GUARANTEED PASS**—You get your FCC License or money refunded. **Send for FREE facts now. MAIL COUPON TODAY!**

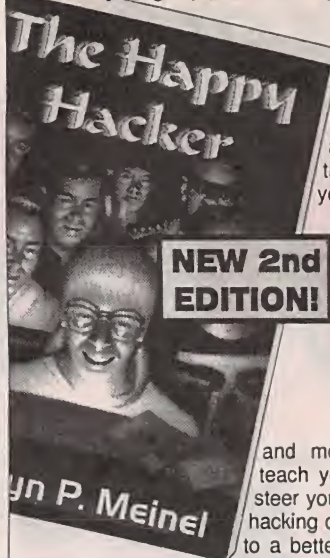
Or, Call 1-800-932-4268 Ext. 210

### COMMAND PRODUCTIONS

FCC LICENSE TRAINING, Dept. 210  
P.O. Box 2824, San Francisco, CA 94126  
Please rush FREE details immediately!

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

## Learn to Hack!



Finally, here is a no-nonsense technical book on computer hacking! In it you will learn how to hack computers you have physical access to and how to hack on the Internet. With this book, you will learn about:

*Finding computers to hack*  
*Breaking into computers*  
*Hacking with Finger*  
*Port surfing*  
*Mapping the internet*  
*Forging E-mail*  
*Fighting spam*  
*E-mail bombs*  
*Hacker wars*

and more! But this book will also teach you how to hack safely. It will steer you clear of the law, so that your hacking career won't lead to prison, but to a better job! **By far, the best book on hacking available today!**

**400 PAGE PAPERBACK, \$34.95 SHIPPING \$3**

**Call (800)719-4957 now!**

to order (Visa/MC/COD) or call or write for **FREE CATALOG** of hard-to-get information about *computer viruses, computer hacking, security and cryptography!!*

Check our web site: [www.logoplex.com/resources/ameagle](http://www.logoplex.com/resources/ameagle)

**American Eagle Publications, Inc.**

**P. O. Box 1507, Dept E.**

**Show Low, AZ 85902**

CIRCLE 270 ON FREE INFORMATION CARD

## CONTROL RELAYS • LIGHTS • MOTORS MEASURE TEMPERATURE • PRESSURE • LIGHT LEVELS • HUMIDITY INPUT SWITCH POSITIONS • THERMOSTATS • LIQUID LEVELS

### MODEL 30 ..... \$79



- PLUGS INTO PC BUS
- 24 LINES DIGITAL I/O
- 8 CHANNEL
- 8 BIT A/D IN
- 12 BIT COUNTER
- UP TO 14K SAMP/SEC

### MODEL 45 ..... \$189



- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

### MODEL 100 ..... \$279



- 12 BIT 100 KHZ A/D
- 4 ANALOG OUTPUTS
- 3 TIMER COUNTERS
- 24 DIGITAL I/O

### MODEL 150-02 .... \$179



- RS-232 INTERFACE
- TRMS, 20 AMPS
- 12 BIT A/D
- OPTO-ISOLATED
- COMPLETE DMM

### MODEL 40 ..... \$109



- RS-232 INTERFACE
- 28 LINES DIGITAL I/O
- 8 ANALOG INPUTS
- PWM OUTPUT

### MODEL 70 ..... \$239



- RS-232 INTERFACE
- 18 BIT A/D
- 5.5 DIGIT
- UP TO 60 SAMP/SEC

## Prairie Digital, Inc.

PHONE 608-643-8599 • FAX 608-643-6754

820 SEVENTEENTH STREET • PRAIRIE DU SAC, WISCONSIN 53578

CIRCLE 315 ON FREE INFORMATION CARD



# MCM ELECTRONICS®

## The Source For All Of Your Electronics Needs

When ordering, please provide this code: **SOURCE CODE: ENS59**

Order  
#50-6265

**ONLY \$99.95**

**NEW**

### 100W Subwoofer Amplifier Module

Ideal for anyone interested in making their own powerful subwoofer. Internally, this amplifier isolates, then sums the left and right inputs to give a single mono channel with 100W RMS output @ 4ohm, 85W RMS @ 8ohm. •Speaker level inputs •Satellite outputs •Line level inputs •Auto turn-on •12dB continuously variable 60Hz~160Hz crossover •Adjustable level control •0°/180° phase selector •Fully sealed rear housing •Requires 8" square opening •Call for larger quantity pricing



Prices Effective May 6  
through June 18, 1999



#28-4796



#28-5115

**CEBEK**

### Pre-Assembled

#### Circuit Modules

Ideal for repairing old equipment, prototype work or your latest project. These well constructed PC boards are fully assembled, tested and ready to use. Supplied with application instructions and technical specifications. All operate from a single 12VDC source. Call your MCM Sales Representative for more information on over 120 available modules.

Order #	Description	Reg.	Sale
28-4795	1W audio amplifier	\$7.49	\$5.99
28-4796	5W audio amplifier	13.95	11.15
28-4800	5W x 2 stereo amplifier	24.95	19.96
28-4801	15W x 2 stereo amplifier	39.95	31.96
28-4851	88-108MHz FM transmitter	24.95	19.96
28-4785	2 digit LED counter	14.95	11.96
28-5115	Flip-flop relay	14.95	11.96
28-4825	VOX relay	17.95	14.36
28-4815	Electric guitar preamplifier	8.95	7.16



**ONLY \$9.95**

Order #28-2200

### Multi-Voltage Power Supply

Fully regulated supply provides up to two amps, at the following selectable voltages: •3 •4½ •6V •7½V •9V •12V. Regular price \$16.95.



Order  
#60-9490

**introductory price**

**\$61.50**

15VDC, 350mA

### Solar "Power Supply"

Intended to maintain car batteries when vehicle is parked for extended periods of time, this solar panel generates 350mA @ 15VDC in full sunlight. Completely weatherproof design is UV/shock/hail resistant. Dimensions: 12" (L) x 12" (W) x 1" (D). Regular price \$74.95.

**ONLY \$19.95**

Order #32-4425

### Remote Control A/B Switch

Remote controlled RF switch allows selection from two sources for output to TV or VCR, via infrared remote. Frequency range: 5MHz~8900MHz. "F" type in/out connections. Remote requires two "AA" batteries not included (#290-070). Regular price \$25.75



**FREE Catalog!**

**Same Day Shipping!**

In stock orders received by 5:00 p.m. (YOUR TIME), are shipped the same day.

**ONLY \$14.95**

Order #29-1335

**BATTERY CS3 Sealed**

### Lead Acid Battery

12.volt, 4.5 amp/hour battery is ideal for security and other power backup applications. 0.25" tabs accept standard quick-disconnects. Dimensions 3½" x 2½" x 4". Regular price \$26.95



Order #82-835

**DEFENDER SECURITY**

### CCD Camera

½" format black and white CCD camera features built-in iris and operates in subdued light to 0.3 lux. Includes 12VDC, 150mA adaptor. NTSC composite video output via BNC connector. Lens not included. Regular price \$129.00

**ONLY \$99.95**

### Lenses

Order #	Description	Viewing Angle	Mount	(ea.)
82-870	4mm	101°	CS	\$59.95
82-875	8mm	40°	C	59.95
82-880	16mm	21°	C	59.95

**ONLY \$39.95**

Order #72-4025

**TENMA® DMM W/Logic Function**

3½ digit DMM measures AC/DC voltage from 200mV~600V, resistance to 2000Mohm, capacitance to 20µF, transistor h<sub>FE</sub> gain and audible continuity test. Requires 9V battery (#290-080) not included. Dimensions: 2½" (W) x 5½" (H) x 1½" (D). Regular price \$65.95.



**MCM ELECTRONICS®**

650 CONGRESS PARK DR.  
CENTERVILLE, OH 45459  
A PREMIER FARNELL Company

**1-800-543-4330**

**www.mcmelectronics.com**

Hours: M-F 7 a.m.-9 p.m., Sat. 9 a.m.-6 p.m., EST.

**SOURCE CODE: ENS59**



## LASER WINDOW BOUNCE LISTENING SYSTEM

Remarkable concept allows user to hear sounds within a premise over a beam of laser light reflected from a window or similar surface. Experimental device provides hours of interesting and educational use. Utilizes a visible red laser that simplifies alignment and discourages illegal use. Usable range will vary-expect about 20 to 50 meters. Optional lens will increase range 200 to 400 meters! Further range requires expensive optics. Basic system setup requires patience in alignment and a sturdy video tripod (not incl.)



Uses Scattered and Direct Reflections

LWB5 Plans.....\$20.00 LWB5K Kit Plans.....\$149.95  
 LWB50 Basic System Assembled and Tested.....\$199.95  
 LWB70 Higher Performance Version With High Coherence Laser Gun Sight, Extending Lens, Delux Headsets.....\$299.95

## LASERS

### SUPER BRIGHT VISIBLE RED POINTERS

- \* Signaling Beacon Visible Over 25 Miles!!
- \* Over 1/2 Mile Pointing Range
- \* Light Up a Low Level Cloud
- \* Great Fun At The Mo
- \* Drive The Cat Nuts!!
- \* 6Hrs On AAA Batteries
- \* 5 5/8x1 1/2" All Metal

LAPN65 15 mw equiv 2000ft.....\$24.95  
 LAPN63 30 mw equiv 4000ft.....\$49.95  
 LAPN63F Above Focusable.....\$54.95

### NEW LASER "LIGHT SHOW" POINTERS

- \* #LAPN6512...12 Design Show.....\$29.95!
- \* #LAPN6524...24 Design Show.....\$34.95!!
- \* #LAPN6540...40+Design Show.....\$39.95!!!

## FM TRANSMITTER KITS

### ALL PARTS TO BUILD 6 LONG RANGE WIRELESS DEVICES

- 1 Super Sensitive Ultra Clear 1 Mile+ Voice Transmitter
- 2 1 Mile+ Telephone Transmitter
- 3 Line Powered Telephone Transmitter Never Needs Batteries!!
- 4 Tracking/Homing Beacon "Beeping Transmitter"
- 5 Transmitter Rebroadcasts Video or Audio Outputs
- 6 Short Range TV/FM Disrupter NEAT PRANK!!! Discretion Advised

All 6 Above Kits Plus FREE Info Data Pack on HELPFUL HINTS Building and Tuning Wireless Devices

COMBOX Parts and Plans for above!.....\$59.95  
 COMBOP Plans for all the above!.....\$10.00

## KINETIC ELECTRIC GUN

PIONEER A FUTURISTIC WEAPON!



500 Joules Energy Storage  
 Constant Current Charging  
 Triggered Spark Switch  
 Ballistic Velocities  
 Handheld Battery Operated  
 Labeled A Dangers product  
 JOIN THE RESEARCH!

EGUN1 Plans with Parts List.....\$20.00  
 All Parts are Individually Available

## 3 MI FM BROADCAST TELEPHONE TRANSMITTER

Tunable On FM Broadcast. Excellent Telephone Project. Only Transmits When Phone is Used  
 VVPM7K Kit/Plans.....\$39.95  
 BEEP1K Beeper Alert Kit.....\$19.95

## 10-14" of Explosive Bolts of Lightning 250KV TESLA COIL

Transmit Wireless Energy  
 Strange and Bizarre  
 pyrotechnical effects.  
 Ion Motors Anti-Gravity  
 Size 20" H x 8" Sq  
 Weight - 25 Pounds  
 115 Volts/2 Amps AC  
 Labeled "Use Caution"

BTC3 Plans.....\$15.00  
 BTC3K Kit/Plans.....\$399.95  
 BTC30 Ready to Use.....\$499.95  
 BTC4 Plans 24 to 30" Sprk.....\$20.00

## HIGH POWER STUNGUNS

STUN100 100KV StunGun.....\$19.95  
 STUN200 200KV StunGun.....\$39.95  
 STUN300 300KV StunGun.....\$49.95

## ION RAY GUN PROJECTS ENERGY!



Star Wars Technology Demonstrates Weapons Potential! See Ions in Motion!

IOG79 Plans.....\$10.00  
 IOG7K Kit/Plans.....\$99.95  
 IOG70 Assembled and Tested.....\$149.95

### HIGHER POWERED DEVICE

IOG9K Kit/Plans.....\$149.95  
 IOG90 Assembled and Tested.....\$199.95

### ATTENTION! HIGH VOLTAGE EXPERIMENTERS

Battery Powered Mini Sized Modules for research in: HOVERCRAFT, ION GUNS, FORCE FIELDS, SHOCKERS  
 MINIMAX4 4KV@10ma.....\$19.95

## GRAVITY GENERATOR

Demonstrates a unique phenomena of electrical reactions that produce the effect of "anti-gravity". You build and levitate a small mock space ship from simple materials. Excellent scientific demonstration of a fascinating method of levitation.



### Levitate an Object!

GRA1 Plans and Book.....\$20.00  
 GRA1K Pwr Sup Kit/Plans.....\$99.95  
 GRA10 Assembled Pwr Sup.....\$149.95

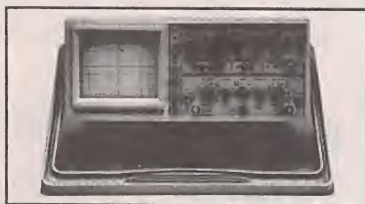
### SHOCK FORCE FIELD/ VEHICLE OBJECT ELECTRIFIER

Hand Shock Balls, Wands, Electrify Objects. Great Payback for Those Wiseguys!  
 SHK1K Kit of Pwr Module.....\$19.95

**1 800 221 1705 ORDERS ONLY! FAX 1 603 672 5406 INFO 9-5pm 1 603 673 4730 FREE CATALOG ON REQUEST**  
 Pay by MC, VISA, Cash, Chk, MO, COD. Please Add \$5.00 S&H plus \$5.00 if COD. Overseas Please Contact for PROFORMA

# New and Pre-Owned Test Equipment

## Goldstar



Model OS-5100 → \$899.00  
**Full 100 MHz Bandwidth!**

- Dual-Channel, High Sensitivity
- TV Synchronization Trigger
- Calibrated Delayed Sweep
- Includes Two Probes, 2 Year Warranty

Spectrum Analyzer  
 Avcom PSA-37D

Satellite Downlink  
 Installation  
 Maintenance & Service

- Band 1 10 - 1750 MHz
- Band 2 3.7 - 4.2 GHz
- Built-In DC Block & Power for LNA/LNB's
- Line or Battery Powered

Only \$2,475.00!

We Buy Surplus  
 Test Equipment

Leader CATV Signal Level Meter Model LF 941

- ✓ TV/CATV Coverage from 46 - 870 MHz
- ✓ Video/Audio Carrier Measurements \$695.00!

Just Released! → "Series III" Multimeters

Fluke Model 87III \$319.00 !!!

## SIMCHECK® II PLUS Module Tester

- \* Tests SIMMs/168 p DIMMs
  - \* Stand alone/portable
  - \* Identifies Module properties
  - \* Advanced Setup Capabilities
- Only \$2750.00!

## Pre-Owned Oscilloscope Specials

Tektronix 2213	60 MHz	\$549.00
Tektronix 2215	60 MHz	\$649.00
Tektronix 465	100 MHz	\$599.00
Tektronix 465B	100 MHz	\$729.00
Tektronix 475	200 MHz	\$829.00
Tektronix 475A	250 MHz	\$999.00

- Professionally Refurbished
- Aligned & Calibrated to Original Specifications
- The Industry Standard of Oscilloscopes
- 1 Year Warranty - The Longest Available!!!

See us on the Web!  
[www.fotronic.com](http://www.fotronic.com)

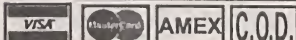
## Test Equipment Depot

A FOTRONIC CORPORATION COMPANY

99 Washington St. Melrose, MA 02176

(781) 665-1400 • FAX (781) 665-0780

email: [sales@fotronic.com](mailto:sales@fotronic.com)



**TOLL FREE 1-800-99-METER**



## World's Smallest TV Transmitters

We call them the 'Cubes'.... Perfect video transmission from a transmitter you can hide under



a quarter and only as thick as a stack of four pennies- that's a nickel in the picture! Transmits color or B&W with fantastic quality - almost like a direct wired connection to any TV tuned to cable channel 59. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Basic 20 mW model transmits up to 300' while the high power 100 mW unit goes up to 1/4 mile. Audio units include sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Any of our cameras have been tested to mate perfectly with our Cubes and work great. Fully assembled - just hook-up power and you're on the air!

C-2000, Basic Video Transmitter Cube.....\$89.95  
C-3000, Basic Video & Audio Transmitter Cube.....\$149.95  
C-2001, High Power Video Transmitter Cube.....\$179.95  
C-3001, High Power Video & Audio Transmitter Cube...\$229.95



## CCD Video Cameras

Top quality Japanese Class 'A' CCD array, over 440 line resolution, not the off-spec arrays that are found on many other cameras. Don't be fooled by the cheap CMOS single chip cameras which have 1/2 the resolution, 1/4 the light sensitivity and draw over twice the current! The black & white models are also super IR (Infrared) sensitive. Add our invisible to the eye, IR-1 illuminator kit to see in the dark! Color camera has Auto gain, white balance, Back Light Compensation and DSPI. Available with Wide-angle (80°) or super slim Pin-hole style lens. Run on 9 VDC, standard 1 volt p-p video. Use our transmitters for wireless transmission to TV set, or add our IB-1 Interface board kit for audio sound pick-up and super easy direct wire hook-up to any Video monitor, VCR or TV with A/V input. Fully assembled, with pre-wired connector.

CCDWA-2, B&W CCD Camera, wide-angle lens.....\$69.95  
CCDPH-2, B&W CCD Camera, slim fit pin-hole lens.....\$69.95  
CCDC-1, Color CCD Camera, wide-angle lens.....\$129.95  
IR-1, IR Illuminator Kit for B&W cameras.....\$24.95  
IB-1, Interface Board Kit.....\$14.95

## Mini Radio Receivers

Imagine the fun of tuning into aircraft a hundred miles away, the local police/fire department, ham operators, or how about Radio Moscow or the BBC in London? Now imagine doing this on a little radio you built yourself - in just an evening! These popular little



receivers are the nuts for catching all the action on the local ham, aircraft, standard FM broadcast radio, shortwave or WWV National Time Standard radio bands. Pick the receiver of your choice, each easy to build, sensitive receiver has plenty of crystal clear audio to drive any speaker or earphone. Easy one evening assembly, run on 9 volt battery, all have squelch except for shortwave and FM broadcast which has handy SCA output. Add our snazzy matching case and knob set for that smart finished look.

AR-1, Airband 108-136 MHz Kit.....\$29.95  
HFRC-1, WWV 10 MHz (crystal controlled) Kit.....\$34.95  
FR-1, FM Broadcast Band 88-108 MHz Kit.....\$24.95  
FR-6, 6 Meter FM Ham Band Kit.....\$34.95  
FR-10, 10 Meter FM Ham Band Kit.....\$34.95  
FR-146, 2 Meter FM Ham Band Kit.....\$34.95  
FR-220, 220 MHz FM Ham Band Kit.....\$34.95  
SR-1, Shortwave 4-11 MHz Band Kit.....\$29.95  
Matching Case Set (specify for which kit).....\$14.95

## Tiny FM Transmitters



Gosh, these babies are tiny - that's a quarter in the picture! Choose the unit that's best for you. FM-5 is the smallest tunable FM transmitter in the world, picks up a whisper 10' away and transmits up to 300'. Runs on tiny included watch battery, uses SMT parts. FM-4 is larger,

more powerful, runs on 5-12 volts, goes up to a mile. FM4.5 operate in standard FM band 88-108 MHz. FM-6 is crystal controlled in 2 meter ham band, 146.535 MHz, easily picked up on scanner or 2 meter rig, runs on 2 included watch batteries. SMT (surface mount) kits include extra parts in case you sneeze & lose a part!

FM-4MC, High Power FM Transmitter Kit.....\$17.95  
FM-5, World's Smallest FM Transmitter Kit.....\$19.95  
FM-6, Crystal Controlled 2M FM Transmitter Kit.....\$39.95  
FM-6, Fully Wired & Tested 2M FM Transmitter.....\$69.95

## Super Pro FM Stereo Transmitter

Professional synthesized FM Stereo station in easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the



FM-100. Set freq with Up/Down buttons, big LED display. Input low pass filter gives great sound (no more squeals or swishing from cheap CD inputs!) Limiters for max 'punch' in audio - without over mod, LED meters to easily set audio levels, built-in mixer with mike, line level inputs. Churches, drive-ins, schools, colleges find the FM-100 the answer to their transmitting needs, you will too. Great features, great price! Kit includes cabinet, whip antenna, 120 VAC supply. We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.

FM-100, Pro FM Stereo Transmitter Kit.....\$249.95  
FM-100WT, Fully Wired High Power FM-100.....\$399.95

## FM Stereo Radio Transmitters

No drift, microprocessor synthesized! Excellent audio quality, connect to CD player, tape deck or mike mixer and you're on-the-air. Strappable for high or low power! Runs on 12 VDC or 120 VAC. Kit includes case, whip antenna, 120 VAC power adapter - easy one evening assembly.



FM-25, Synthesized FM Stereo Transmitter Kit.....\$129.95



Lower cost alternative to our high performance transmitters. Great value, tunable over FM band, plenty of power and manual goes into great detail about antennas, range and FCC rules. Handy kit for sending music thru house and yard, ideal for school projects too - you'll be amazed at the exceptional audio quality! Runs on 9V battery or power from 5 to 15 VDC. Add our matching case and whip antenna set for a nice 'pro' look.

FM-10A, Tunable FM Stereo Transmitter Kit.....\$34.95  
CFM, Matching Case and Antenna Set.....\$14.95  
FMAC, 12 Volt DC Wall Plug Adapter.....\$9.95

## RF Power Booster

Add muscle to your signal, boost power up to 1 watt over a freq range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM transmitters, providing radio service through an entire town. Runs on 12 VDC. For a neat finished look, add the nice matching case set.



LPA-1, Power Booster Amplifier Kit.....\$39.95  
CLPA, Matching Case Set for LPA-1 Kit.....\$14.95  
LPA-1WT, Fully Wired LPA-1 with Case.....\$99.95

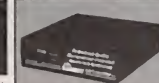
## FM Station Broadcast Antenna



For maximum performance, a good antenna is needed. Properly tuned and matched antenna is fully PVC enclosed for weather protection and rugged use. Vertical or horizontal mounting, 'F' style connector, 5' long.

TM-100, Tru-Match FM Station Antenna Kit.....\$39.95

## AM Radio Transmitter



Operates in standard AM broadcast band, set to clear channel in your area. AM-25 'pro' version is synthesized for stable, no-drift frequency and is settable for high power output where regulations allow, typical range of 1-2 miles. Entry-level AM-1 has tunable transmit oscillator, runs FCC maximum 100 mW power, expected range 1/4 mile. Both accept line-level inputs from tape decks, CD players or mike mixers, run on 12 volts DC. Pro AM-25 includes AC power adapter, matching case and bottom loaded wire antenna. Entry-level AM-1 has an available matching case and knob set for a finished, professional look. High level modulation for low distortion.

AM-25, Professional AM Transmitter Kit.....\$129.95  
AM-1, Entry level AM Radio Transmitter Kit.....\$29.95  
CAM, Matching Case Set for AM-1.....\$14.95

## RAMSEY

## Binocular Special

Wow, did we nab a deal on these first rate binoculars! Absolutely identical to a famous big name brand here in Rochester, NY - but without 'their' name. Well made with fully coated optics, super nice rubber armored housing over hi-alloy aluminum, includes lens cleaner cloth, neck lanyard and carry case. 4 styles: roof prism 10x25 (10 power, 25 mm), 10x25 high performance roof prism ruby coated objective lens model for demanding use in bright sun, 10x25 high-end BAK-4 lens porro prism ruby coat with TacGrip housing, and Ultra-View 10x50 porro prism ruby coats. First quality, yet at a close-out price on the exact same units as the 'Trademarked' units - but at half price!



BNO-M, 8x21 Mini Monocular.....\$14.95  
BNO-1, 10x25 Roof Prism Binoculars.....\$24.95  
BNO-1EX, 10x25 Ruby Coated Porro Prism.....\$29.95  
BNO-2, 10x25 TacGrip Ruby Coat Porro Prism.....\$59.95  
BNO-6, 10x50 Ultra-View Ruby Coat Porro Prism...\$69.95

## World's Smallest FM Radios

Everyone who sees one of these babies says they just gotta have one! Super cute tiny FM radios have automatic scan/search tuning, comfortable ear bud earphones and we even include the battery. The pager style unit looks like a shrunken pager and even has an LCD clock built-in. You will be amazed at the crystal clear amazing sound! That's a quarter in the picture for size comparison - pretty tiny, huh?



MFMT-1, World's Smallest FM Radio.....\$11.95  
PFMR-1, Pager Style LCD Clock & FM Radio.....\$12.95

## Speech Descrambler

Decode all that gibberish! This is the popular descrambler / scrambler that you've read about in all the Scanner and Electronic magazines. Speech inversion technology is used, which is compatible with most cordless phones and many police department systems, hook it up to your scanner speaker terminals and you're in business. Easily configured for any use: mike, line level and speaker output/inputs are provided. Also communicate in total privacy over telephone or radio, full duplex operation - scramble and unscramble at the same time. Easy to build, all complex circuitry contained in new custom ASIC chip for clear, clean audio. Runs on 9 to 15VDC. Our matching case set adds a professional look to your kit.



SS-70A, Speech Descrambler/Scrambler Kit.....\$39.95  
CSS, Custom Matching Case and Knob Set.....\$14.95  
SS-70AWT, Fully Wired SS-70A with Case.....\$79.95  
AC12-5, 12 Volt DC Wall Plug Adapter.....\$9.95

## Call for our Free Catalog!

See our complete catalog and order on-line with our secure server at:

[www.ramseyelectronics.com](http://www.ramseyelectronics.com)

RAMSEY ELECTRONICS, INC.

793 Canning Parkway Victor, NY 14564

Order Toll-free: 800-446-2295

Sorry, no tech info, or order status at this number

For Technical Info, Order Status  
Call Factory direct: 716-924-4560



ORDERING INFO: Satisfaction Guaranteed. Examine for 10 days, if not pleased, return in original form for refund. Add \$6.95 for shipping, handling and insurance. Orders under \$20, add \$3.00. NY residents add 7% sales tax. Sorry, no CODs. Foreign orders, add 20% for surface mail or use credit card and specify shipping method.



**CALL TOLL FREE**  
**(800) 292-7711**  
**Orders Only**  
**Se Habla Español**

# C&S Sales

**Excellence in Service**

**Look For Other  
 Monthly Specials  
 On Our Website**

**www.cs-sales.com**

## Power Supplies

### Elenco Quad Power Supply Model XP-581

**\$79.95**



**4 Fully Regulated DC Power  
 Supplies in One Unit**

4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A  
 1 Variable - 2.5 - 20V @ 2A

### Elenco Power Supply Kit Model XP-720K

**\$54.95**

- 1.5VDC - 15VDC @ 1A
- -1.5VDC - -15VDC
- 5VDC @ 3A
- 6.3VAC @ 1A & 12.6VAC center tapped @ 1A



XP-720 Fully Assembled **\$85**

### Elenco DC Power Supply

Model SPL-603 **\$79.95**  
 3A 0-30VDC

The SPL-603 is a solid-state DC power supply providing the exact output voltage no matter what current you use. It contains one fully regulated power supply. The variable voltage is capable of delivering 0-30V at up to 3A. The output is precisely held to the desired output voltage by a special regulating circuit. Output fully protected from overload.



## Miscellaneous

### Elenco Model EP-50

Electronic Playground  
 and Learning Center  
 Contains Over 50  
 Experiments

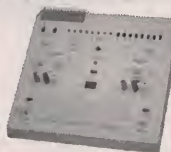
**\$19.95**



### Elenco Model XK-150

Digital/Analog  
 Trainer

**\$89.95**



Ideal for Schools

### Elenco Model MX-9300 Four Functions in One



**\$450**

#### Features:

- One instrument with four test and measuring systems:
- 1.3GHz Frequency Counter
- 2MHz Sweep Function Generator
- Digital Multimeter
- Digital Triple Power Supply - 0-30V @ 3A, 15V @ 1A, 5V @ 2A

## Generators & Counters

### Elenco Sweep Function Generator w/ built-in frequency counter Model GF-8036



**\$225**

This sweep function generator with counter is an instrument capable of generating square, triangle, and sine waveforms, and TTL, CMOS pulse over a frequency range from 0.2Hz to 2MHz.

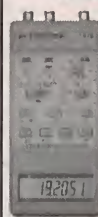
### 10 Function 1.3GHz Universal Counter Elenco Model F-1300

- Frequency .05Hz - 1.3GHz 3 Ranges
- Period - Can read 60Hz to 60,000,000 F=1/T
- Totalsize - Counts to 199,999,999
- RPM - 3 to 2099994 RPM
- Duty Cycle
- Max/Min/AVG with Time
- Stop-switch set 2 sec. to 100 hrs.
- Math Functions
- Timer - 2 sec. to 99 days
- Pulse Width - 0.1ms to 66666.6ms

**\$225**



### Multifunction Counter B&K Model 1875



10Hz - 2.5GHz  
**\$189**

Ultra sensitive  
 synchronous  
 detector bar-  
 graph and RF  
 strength.  
 3 Channels

### Elenco Handheld Universal Counter Model F-2800



**\$99**

Features 10 digit display, 16 segment and RF signal strength bar-graph. Includes antenna, NiCad battery, and AC adapter.

### Elenco RF Generator with Counter (100kHz - 150kHz) Model SG-9500



Features internal AM mod. of 1kHz, RF output 100MV - 35MHz. Audio output 1kHz @ 1V RMS.

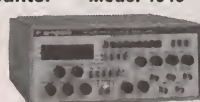
**\$225**

SG-9000 ..... \$119.95  
 (analog, w/o counter)

### B&K 20MHz Sweep/Function Generator with Frequency Counter Model 4040

- 0.2Hz to 20MHz
- AM & FM modulation
- Burst Operation
- External Frequency counter to 30MHz
- Linear and Log sweep

**\$399**



10MHz Model 4017 \$309  
 5MHz Model 4011 \$249

**BK PRECISION**

## Kit Corner

over 100 kits available

### Model AK-870

Radio Control Car Kit

**\$24.95**

- Solderless
- 7 Functions
- Radio Control Transmitter Included



### Model AK-700

Pulse/Tone  
 Telephone Kit

Ideal  
 School  
 Project

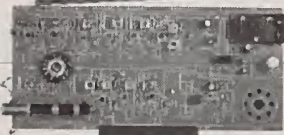


**\$15.95**

### Model AM/FM-108K

AM/FM  
 Transistor  
 Radio Kit  
 w/ Stand

**\$29.95**



## Elenco Digital / Analog Trainer

### Model XK-700

Elenco's newest advanced Digital / Analog Trainer is specially designed for school projects. It is built on a single PC board for maximum reliability. It includes 5 built-in power supplies, a function generator w/ continuously sine, triangular and square waveforms, 1,560 tie point breadboard area. Tools and meter shown optional. (Mounted in a professional tool case made of reinforced metal).

XK-700  
 Assembled & Tested  
**\$189.95**

XK-700K - Kit  
**\$159.95**



**Made in USA**

## Guaranteed Lowest Prices

UPS SHIPPING: 48 STATES 5%  
 OTHERS CALL FOR DETAILS  
 IL Residents add 8.25% Sales Tax

## C&S SALES, INC.

150 W. CARPENTER AVENUE  
 WHEELING, IL 60090  
 FAX: (847) 541-9904 (847) 541-0710



**15 DAY MONEY BACK GUARANTEE  
 2 YEAR FACTORY WARRANTY**

PRICES SUBJECT TO CHANGE WITHOUT NOTICE



**SAME DAY  
SHIPPING**

# C&S Sales

**Excellence in Service**

**CALL OR WRITE  
FOR OUR  
FREE  
64 PAGE CATALOG!  
(800) 445-3201**

## Digital Multimeters

### Elenco LCR & DMM Model LCM-1950



12 Functions  
Freq. to 4MHz  
Inductance  
Capacitance  
and Much More

**\$69**

### Elenco Model M-1740



**\$39.95**

11 Functions:  
• Freq. to 20MHz  
• Cap. to 20µF  
• AC/DC Voltage  
• AC/DC Current  
• Beeper  
• Diode Test  
• Transistor Test  
• Meets UL-1244 safety specs.  
Model M-2760 - \$24.95  
(9 functions)

### Fluke 79III



**\$185**

• Capacitance ranges from 99.99nF to 9999µF.  
• Built-in frequency counter of voltage input from 1Hz to over 20kHz.  
• Lo-Ohms range, a 40Ω range with Fluke's proprietary Zero Calibration, offers 0.01 resolution with increased noise rejection.

Series II (limited qty.)  
**\$179**

### Fluke 87III



**\$299**

Features high performance AC/DC voltage and current measurement, frequency, duty cycle, resistance, conductance, and capacitance measurement.

Series II (limited qty.)  
**\$289**

### Elenco Model LCR-1810



**\$99.95**

• Capacitance: 1pF to 20µF  
• Inductance: 1µH to 20H  
• Resistance: 0.1Ω to 2000MΩ  
• Temperature to 750°C  
• DC Volts 0 - 20V  
• Frequency up to 15MHz  
• Diode/Audible Continuity Test  
• Signal Output Function  
• 3 1/2 Digit Display

### Elenco Model M-1005K



**\$14.95**

Digital  
Multimeter Kit

• 18 Ranges  
• 3 1/2 Digit LCD  
• Transistor Test  
• Diode Test

M-1000B (Assembled) ..... **\$14.95**

### Dual-Display LCR Meter w/ Stat Functions B&K Model 878



**\$219.95**

Auto/manual  
range

Many features  
with Q factor  
High Accuracy

### B&K Model 5390



**\$295**

• 50,000 Count  
• 0.025% DCV  
• True RMS, AC or AC+DC  
• 0.07% ohms  
• 100kHz AC Response  
• Autoranging, Bargraph with Zoom.  
• Capacitance to 50,000µF  
• Frequency, Duty Cycle, Pulse Width  
• dB across 1Ω to 10kΩ  
• Disturbance Indicator

## Oscilloscopes

Free Dust Cover and 2 Probes



S-1325	25MHz	Dual Trace	\$325
S-1330	25MHz	Delayed Sweep	\$439
S-1340	40MHz	Dual Trace	\$475
S-1345	40MHz	Delayed Sweep	\$569
S-1360	60MHz	Delayed Sweep	\$749
S-1390	100MHz	Delayed Sweep	\$995

### DIGITAL SCOPE SUPER SPECIALS

DS-203	20MHz/10Ms/s Analog/Digital	\$695
DS-303	40MHz/20Ms/s Analog/Digital	\$995
DS-603	60MHz/20Ms/s Analog/Digital	\$1295

## TEKK Radios

Both Models  
Available  
In Yellow,  
Blue & Black

### Pro-Sport FRS Two-Way Radio Model PRO-SPORT+

Talk up to  
2 miles!

#### Model PRO-SPORT

• 1/2 Watt Output, 14 Channels.  
• TX LED Indicator.  
• Removable Belt Clip.  
• Highly Water Resistant.  
• Economy Type  
• No License Required!

**\$68.00 each or  
2 for \$109.95**



No  
License  
Required

#### Model PRO-SPORT +

• 1/2 Watt Output, 14 Channels.  
• TX & RX LED/LCD Indicators.  
• Large LCD Display.  
• 38 Privacy (CTCSS) Tones.  
• Plus All Features of Pro-Sport Model.

**\$79.00 each or  
2 for \$149.95**



## Elenco Technician Tool Kit

Model TK-1500 **\$49.95**

28 tools plus a DMM (M-1000B) contained in a large flexible tool case with a handle ideal for everyone on the go.



## Guaranteed Lowest Prices

UPS SHIPPING: 48 STATES 5%  
OTHERS CALL FOR DETAILS  
IL Residents add 8.25% Sales Tax  
**SEE US ON THE WEB**

## C&S SALES, INC.

150 W. CARPENTER AVENUE  
WHEELING, IL 60090  
FAX: (847) 541-9901 (847) 541-0710  
→ [www.cs-sales.com](http://www.cs-sales.com)

**15 DAY MONEY BACK GUARANTEE  
2 YEAR FACTORY WARRANTY**

PRICES SUBJECT TO CHANGE WITHOUT NOTICE



# SUPERCIRCUITS

America's #1 Microvideo Source

AMAZING!

## MICRO VIDEO TOP 10

OVER 120 NEW VIDEO PRODUCTS!

1. World's Smallest Video Camera\* ..... 1 lux, .3oz. \$59.95
2. Pinhole Video Camera... 410 lines, 0.5 lux, Sharp chip \$39.95
3. Color Video Camera.... 350 lines, 2 lux, Remote head \$69.95
4. Live R/C Aerial Videotape ..... How to's and more \$24.95
5. Wireless Covert Tape Cam.... 300' range, FCC OK \$349.95
6. Super Tiny Color Pinhole Cam.... 350 lines, 1" sq. \$89.95
7. Micro Video Transmitter ..... 1000' range, ATV band \$159.95
8. Complete Wireless ATV Video Set .3 miles range \$419.95
9. World's Smallest Wireless Video Cam..... Please Call
10. Video Goggles..... Dual hi-res LCD's, 3D capable \$599.95

If you're looking for the best in microvideo...  
Call us today and get our new 72 page catalog!

**1-800-335-9777 ext ES**

Or fax us at 512-260-0444

**www.supercircuits.com**

\* See video from Supercircuits PC-67XS spacecam on our web site...also live R/C plane aeriels!



Used on  
NASA Space  
Flight\*

Call Today And  
**SAVE!** **Unbeatable PRICES!**

## CABLE TV

**DESCRAMBLERS  
CONVERTERS • FILTERS  
VIDEO STABILIZERS**

**FREE** ➤ 30 Day Trial  
**FREE** ➤ Product Catalog  
**FREE** ➤ 1 Year Warranty

**100% MONEY BACK GUARANTEE**



Let us point you in  
the right direction ...

**Arrow**  
Technologies  
Omaha, Nebraska

**TOLL FREE  
888-554-ARROW**  
**888-554-2776**

Introducing...

**The  
Epic Series**

**NEW**

**280 different configurations in a  
single size, snap-in mounted case**

*Create a look of conformity on panels*



**KNS**  
Instruments

Visit our catalog on the web: **www.knsinstruments.com**

**800-356-4920**

Choose from:

- ▼ 3 1/2 or 4 1/2 digit displays
- ▼ voltage or process loop inputs
- ▼ black, red, amber or green numerals
- ▼ black numerals with lighted green background

Features:

- ▼ selectable, displayed engineering units
- ▼ resistant to RF and EMI
- ▼ economically priced
- ▼ five year warranty



PO Box 10158  
Bedford, NH 03110-0158  
Fax 800-356-1250

### EZ-EP DEVICE PROGRAMMER - \$169.95

Check Web!! -- **www.m2l.com**

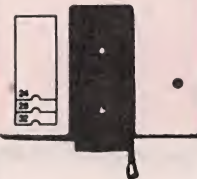
- Fast** - Programs 27C010 in 23 seconds
- Portable** - Connects to PC Parallel Port
- Versatile** - Programs 2716-080 plus EE and Flash (28F,29C) to 32 pins
- Inexpensive** - Best for less than \$200

- Correct implementation of manufacturer algorithms for fast, reliable programming.
- Easy to use menu based software has binary editor, read, verify, copy, etc. Free updates via bbs or web page.
- Full over current detection on all device power supplies protects against bad chips and reverse insertion.
- Broad support for additional devices using adapters listed below.

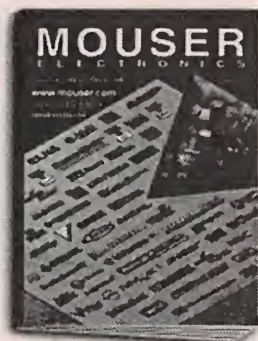
Available Adapters	
EP-PIC (16C5x, 61, 62x, 71, 84)	\$49.95
EP-PIC64 (62-5, 72-4)	\$39.95
EP-PIC12 (12C50x)	\$39.95
EP-PIC17 (17C4x)	\$49.95
EP-51 (8751, C51)	\$39.95
EP-11E (68HC11 E/A)	\$59.95
EP-11D (68HC11D3)	\$39.95
EP-16 (16bit 40pin EPROMs)	\$49.95
EP-28 (Z86E02, 3, 4, 6, 7, 8)	\$39.95
EP-SEE2 (93x, 24x, 25x, 85x)	\$39.95
EP-750 (87C750, 1, 2)	\$59.95
EP-PEEL (IC22v10, 18v8)	\$59.95
EP-1051 (89C1051, 2051)	\$39.95
EP-PLCC (PLCC EPROMs)	\$49.95
EP-SOIC (SOIC EPROMs)	\$49.95
Many Other Adapters Available	

**M<sup>2</sup>L Electronics**  
970/259-0555 Fax: 970/259-0777  
361 S Camino Del Rio Suite #119, Durango,  
CO 81301, CO orders add 7% sales tax.  
<http://www.m2l.com>

**EZ-EP**  
**M<sup>2</sup>L ELECTRONICS**  
Los Angeles, California



**ELECTRONIC COMPONENTS**



Visit our web site!  
**www.mouser.com**

Subscribe, download, or  
view catalog online!

- Over 84,000 Products
- More than 145 Suppliers
- Same Day Shipping
- No Minimum Order

**800-992-9943**

817-483-6828 Fax: 817-483-6899  
catalog@mouser.com

958 North Main St., Mansfield, TX 76063

CIRCLE 318 ON FREE INFORMATION CARD



Since 1971

**www.WEB-TRONICS.com**

You'll  
"Bookmark"  
This Site!

**Circuit  
Specialists  
Inc.**

**B/W Board Camera  
with Infra-Red  
ONLY \$59**

Part #VMCB-21  
And that's not all!



**Full-Sized, Full Featured  
DMM  
ONLY \$19**

Part #9300G  
Even includes the  
rubber boot



**Hard Drive  
Slide Rack  
for 3.5" IDE  
Drives  
ONLY \$14.95**

Part #RH-10C-IDE  
Allows for easy  
removal of hard  
drives. Includes key-lock!



**Color Board Cameras  
with Audio Function  
ONLY \$144**

Part #VM3010-A  
We also have great  
deals on bullet (B/W &  
color) cameras,  
pinhole cameras (B/W & color), some  
with audio. Get specs, details &  
prices from our web site.



**Electronic Soldering Station  
with Ceramic Heating Element,  
3-Conductor Grounded Power  
Cord, 250-  
480°C (470-  
900°F) Fast  
Heating  
ONLY \$39**

Part #SR-976  
Extra tip selection on our web site.



Get all of the specifications and details on these items  
and thousands of other electronic components, test  
equipment, PCB supplies, computer parts, and much  
much more at [www.web-tronics.com](http://www.web-tronics.com).  
Secure on-line ordering, or by FAX, toll free, or snail mail.  
Please check our web site  
for the latest prices.

**Circuit Specialists, Inc.**  
800-528-1417/(602)464-2485  
FAX (602)464-5824



## ❖ ATTENTION ❖ CABLE VIEWERS

CABLE VIEWERS ... get back to your

**BASIC** Cable Needs

**Call 1-800-577-8775**

For information regarding all of your **BASIC** cable needs.

**5 GOOD REASONS  
TO BUY OUR FAR SUPERIOR PRODUCT**

- ❖ PRICE
- ❖ EFFICIENT SALES AND SERVICE
- ❖ WE SPECIALIZE IN 5, 10 LOT PRICING
- ❖ ALL FUNCTIONS (COMPATIBLE WITH ALL MAJOR BRANDS)
- ❖ ANY SIZE ORDER FILLED WITH SAME DAY SHIPPING

We handle **NEW** equipment **ONLY** -

Don't trust last years

**OBSOLETE** and **UNSOLD** stock!

**COMPETITIVE PRICING - DEALERS WELCOME**



**BASIC  
ELECTRICAL  
SUPPLY &  
WAREHOUSING  
CORPORATION**

It is not the intent of B.E.S.W. to defraud any pay  
television operator and we will not assist any  
company or individual in doing the same.  
\*Refer to sales personnel for specifications.

P.O. Box 8180 • Bartlett, IL 60103-8180 • 847-584-2099

**Real Beauties** They Could be Yours

NETCOM since 1983

**ICMaster**  
\$195 Publisher

Oh-My-God!

buy a computer,

get an **ICMaster**

**\$29!**

**Bible**  
of the IC Industry  
Every Cross-reference  
3 Volume Set with Tons of Information

	with computer	alone	regular
\$29 95 edition	\$49	\$69	
\$39 96 edition	\$59	\$89	
\$49 97 edition	\$69	\$109	

Mega Sale ends soon

2 Easy payments of

**\$199!**

On Credit Cards only

**Web CRUISER**  
Compaq LTE LITE 486 DX433

8.5" Active Matrix Display (Sharper & Brighter than standard display)  
230m Standard Hard Drive -or- (810meg \$29 option)  
12M Ram / Internal 14.4k FAX Modem -and-  
You can add an External 28.8k Modem for \$19 -or-  
External 33k Modem for \$39  
3.5 Floppy / All Standard Ports on rear  
EJECTABLE: Battery & Ram  
Power Supply / LIFETIME Compaq Tech Support  
Internet Ready / Owners Manual Software & Win  
Hydride Battery (2X the Power) \$150 Value FREE

2 Easy payments of **\$288!**

On Credit Cards only

**CRUISER & Work Horse**  
Compaq LTE ELITE 486 DX475

9.5" Active Matrix Display (Sharper & Brighter than standard)  
810m Standard Hard Drive -or- (1gig \$29 option)  
16M Ram Standard -or- (24M \$39 option / 32M \$59)  
28.8k FAX MODEM -or- (33k option \$25)  
2-PCMCIA Expansion Slots & All Standard Ports  
EJECTABLE: Battery, Hard Drive & Ram  
Expandable & Upgradable / Lifetime Compaq Tech Support  
Built-in Power Supply / Optional Compaq ELITE Case \$29  
Internet Ready / Owners Manual Software & W95  
Hydride Battery (2X the Power) \$150 Value FREE

2 Easy payments of **\$448!**

On Credit Cards only

**NETWORK READY WORKSTATION**  
Compaq LTE ELITE Pentium 90

10.5" ACTIVE Display (Sharper & Brighter)  
24M Ram / 810 Meg Hard Drive / CD Rom  
2-PCMCIA, Infrared, & All Standard Ports on rear w/ Mic  
33 FAX-MODEM/Stereo Sound/LIFETIME Compaq Support  
EJECTABLE: Battery, Hard Drive, Floppy, CD & Ram  
Includes 2 Power Supplies (1 in Docking Station)  
Internet Ready / Owners Manual Software & W95  
Hydride Battery (2X the Power) \$150 Value FREE

**INCLUDES DESKTOP Docking Station**

**Converts your laptop to a desktop**

2-PCMCIA Ports & 2-Bays for optional drives (any type!)  
Stereo Speakers / Infrared Port / System Status Lights  
2-types of Network connection RJ & Coax  
Monitor Platform included

**IBM Warrior**



**IBM Warrior**  
2 Easy payments of **\$399!**  
Credit Cards only  
for **HARSH ENVIRONMENTS**  
**OUTDOOR DIRECT SUNLIGHT**  
**Water Resistant!**

Silicone Rubberized & Diecast Case!  
Ultra Shock Mounted 1GiG EIDE Hard Drive!  
**INSTANT ON! ZERO BOOT UP TIME!!!!**  
PCMCIA, Serial & Parallel Ports in rear / 3.5 Floppy  
16m Ram / 1m Video/Local Bus 486-50 mhz & Math Co  
28.8k Modem (Internet Ready), Speaker Phone  
4+hours Battery Operation! / Sound & Microphone  
8.25" Display-256 Shade Monochrome REFLECTIVE  
Touch Screen with Handwriting Recognition  
Roxanne's Voice Annotates all Windows 3.X Functions  
Unit Compatible with W95 / Optional 12V Car cord \$29

Questions 843-650-5700

Orders Only 800-733-3733

Intrn Orders [netcomd@aol.com](mailto:netcomd@aol.com) 10-9 EST

FAX 843-650-5777 7 Days

June 1999, Electronics Now

53



2539 W. 237th Street, Bldg. F, Torrance, CA 90505  
 Order desk only: USA: (800) 872-8878 CA: (800) 223-9977  
 LA. & Technical Info: (310) 784-5488 Fax: (310) 784-7590  
 OEM INQUIRIES WELCOME

## TIMELINE INC.

Over 13 years and 31,000 customers and still growing

Minimum Order: \$20.00. Minimum shipping and handling charge \$5.00. We accept cashiers checks, MC or VISA. No personal checks or CODs. CA residents add 8.25% sales tax. We are not responsible for typographical errors. All merchandise subject to prior sale. Phone orders welcome. Foreign orders require special handling. Prices subject to change without notice. 20% restocking fee for returned orders.

### LIQUID CRYSTAL DISPLAYS

**240x64 dot LCD with built-in controller.**  
 AND 4021ST-EO. Unit is EL back-lit. \$59.00 or 2 for \$109.00 or  
 OPTREX. DMF5005 (non back-lit) \$49.00 or 2 for \$89.00  
 20 character x 8 line 7/16" x 2 1/4" The built-in controller allows you to do text and graphics.

### Alphanumeric—parallel interface

16x1.....\$7.00	20x2.....\$10.00	32x2.....\$8.00
16x1 (lg. char.).....\$10.00	20x4.....\$15.00	40x1.....\$8.00
16x2.....\$7.00	20x4 (lg. char.).....\$10.00	40x2.....2 for \$20.00
16x2 (lg. char.).....\$10.00	24x2.....\$10.00	40x4.....\$20.00
16x4.....\$15.00	32x4.....\$10.00	4x2.....\$5.00

5V power required • Built-in C-MOS LCD driver & controller • Easy "microprocessor" interface • 98 ASCII character generator • Certain models are backlit, call for more info.

### Graphics and alphanumeric—serial interface

size	Mfr.	price	size	Mfr.	price
640x480 (backlit)	Epson	\$25.00	480x128	Hitachi	\$10.00
640x400 (backlit)	Panasonic	\$20.00	256x128	Epson	\$20.00
640x200	Toshiba	\$15.00	240x128 (backlit)	Optrax	\$20.00
480x128 (backlit)	ALPS	\$10.00	240x64	Epson	\$15.00
			160x128	Optrax	\$15.00

**6" VGA LCD 640X480, Sanyo LMDK55-22 \$25.00**

### MONITORS

#### Non-Enclosed TTL

Comes with pinout. 12V at 1.4 Amp input • Horizontal frequency 15KHz. • Ability to do 40 and 80 column.  
**5 inch Amber \$25.00 • 7 inch Amber \$25.00**  
**9 inch Amber or Green \$25.00**

#### 5" COLOR MONITOR \$39.00

- Flat Faceplate • 320 x 200 Dot Resolution • CGA & Hercules Compatible
- 12 VDC Operation • 15.75 KHz Horiz. Freq. • 60 Hz Vert. Sync. Freq.
- Open Frame Construction • Standard Interface Connector • Degaussing Coil included • Mfr. Samtron

2 for \$69.00

**9" COLOR SVGA MONITOR \$179.00** Fully Enclosed - Tilt and swivel type.

### POS & BAR CODE

#### MAGNETIC CARD READER \$25.00

Includes: • 20 character dot matrix display with full alpha-numeric capability • keypad with full alpha-numeric entry • separate 7.5 VDC/0.5 Amp power supply • standard telephone interface extension cord • lithium battery and flat-cone speaker.

HP bar code wand (HBSC 2300) \$19.00

### HACKER CORNER

#### EMBEDDED 486 COMPUTER \$99.00

Complete enhanced Intel 486SX-33 based computer in ultra small (9-7/8" x 6-5/8" x 3-1/4") case. Ideal for embedded operations or as a second computer. Features include: • One 16 bit ISA slot • 3 serial ports plus dedicated printer port • Parallel optional coupled adapter port • Built in IBM PC/AT keyboard port • On board VGA video and port • Uses standard SIMM up to 32 MB • BIOS is PC/AT compatible

Unit has a backup Ni-Cd battery system in case of power failure (5 min. backup time) and lockable front cover to prevent floppy drive access. Mounting / interface provisions for standard 3.5" laptop floppy and 2.5 inch hard drives. Comes with very comprehensive manual.

#### SONY Miniature Color LCD Display (LCX005BK8) \$29.00

• 1.4 CM (0.55 inch) Diagonal Full Color Display • Built In Horizontal and Vertical Drivers • Delta Dot Pattern for High Picture Quality - 537 dots (H) x 222 dots (V) • Compatible with NTSC & PAL Format and Sync Inputs • 12 VDC Operation with -1 to +17 V RGB Signal and Driver Input Voltage • Excellent Display for Virtual Reality Projects, Viewfinders, and Miniature Test Equipment Displays • Pin Outs and Specification Included • Unit Requires Clock, Synchronization and Video

#### CELL SITE TRANSCIVER \$49.00 2 for \$89.00

These transceivers were designed for operation in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870,030-889,980 MHz with the receive channels 45 MHz below those frequencies. A digital synthesizer is utilized to generate the selected frequency. Each unit contains two independent receivers to demodulate voice and data with a Receive Signal Strength Indicator (RSSI) circuit to select the one with the best signal strength. The transmitter provides a 1.5 watt modulated signal to drive an external power amplifier. Channel selection is accomplished with a 10 bit binary input via a connector on the back panel. Other interface requirements for operation are 26 VDC (unregulated) and an 18.990 MHz reference frequency for the digital synthesizer. The units contain independent boards for receivers, exciter, synthesizer, tunable front end, and interface assembly (which includes power supplies and voltage-controlled oscillator). Service manual, schematics and circuit descriptions included.

#### Encased Spread Spectrum RF Modem \$99.00

The ProLink Radio Module is a small communication device which replaces cables between RS-232 devices with wireless RF (Radio Frequency) technology. Attaching a pair of ProLinks to any two devices with three wire asynchronous RS-232 ports allows wireless data transmission at rates up to 19.2 Kbaud (full duplex) over a range of 500 - 800 feet. Modules use 900 MZ spread spectrum radio for communication which does not require an FCC site license. A variety of configuration information (radio channel, baud rate, serial port configuration, etc.) can be programmed into module's non-volatile memory by host PC to provide compatibility and avoid overlapping systems. Configuration changes are supported by menu driven, on-board software. Commonly used Terminal Emulation software and transfer protocols can be used for configuring modules and transferring data between computers. ProLinks require only 6-9 VDC (350 mA), RS-232 (9 pin sub - D) interface, and small (- 4") whip antenna for operation. Unit size is 4.0" x 6.5" x 0.75". Installation schematics and application details available. These are 100 Mw power.

#### COLOR CCD CAMERA \$89.00

Small fully enclosed color CCD camera ideally suited for video conference and mobile operations. No separate power supply or batteries needed - single 5 VDC power requirement can be obtained from PC keyboard interface or directly from the computer using the included adapter plugs. Standard NTSC composite output from 1/4" color CCD sensor with 250,000 pixels and automatic white balance.

CIRCLE 275 ON FREE INFORMATION CARD

# ELECTRONIX EXPRESS

#### WELLER SOLDERING STATION - MODEL WLC 100

- Variable power control (5 to 40 watts)
- Replaceable heating element
- Quality light-weight pencil iron

\$36.95



**DUAL-TRACE OSCILLOSCOPE**  
 W/HIGH RESOLUTION, BLUE CRT  
 INCLUDES PROBES, POWER CORD  
 2 YEAR WARRANTY  
 Goldstar 5020  
 20MHZ **\$349.00**

**Instek® FUNCTION GEN.**  
 WITH INT/EXT  
 FREQ. COUNTER  
 MODEL 8016 **\$215.00**



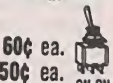
**SCOPE PROBE 60 MHZ**  
 SWITCHABLE X1, X10 **\$12.95**

**ALLIGATOR LEADS**  
 SET OF 10 **\$2.10**



**DIGITAL MULTIMETER**  
 WITH CAP/FREQUENCY/  
 TRANSISTOR TESTER  
 Model DM645 **\$34.95**

**SWITCHES**  
 8 POS DIP ..... 60¢ ea.  
 Mini Toggle SPDT ..... 50¢ ea.



**PAD-234**  
**DIGITAL/ANALOG TRAINER**  
 Complete portable workstation. Variable and fixed power supplies, function generator, digital I/O, rugged design, high impact case.



Assembled **\$150.00**  
 Kit **\$110.00**

#### HIGH QUALITY TOOLS

With Cushion Grips and Return Spring

Needle Nose Pliers **\$2.95**  
 Wire Stripper **\$1.50**  
 Diagonal Cutter **\$2.95**

#### POWER SUPPLIES

0-30 VDC, 0-3 Amp. Built-in current limiting, overload protected, constant voltage and current operation.



01PSGP4303A Analog Display **\$165.00**  
 01PSGP4303D Digital Display **189.00**

#### SOLDERLESS BREADBOARD

830 tie points. MB102PLT model features 3 binding posts and aluminum backplate.

Part No. 1-9 10+  
 MB102 5.95 5.00  
 MB102PLT 8.95 8.00

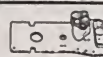


**HELPING HAND WITH MAGNIFIER**  
 #060836 **\$3.50**



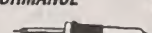
**RESISTOR KIT**  
 1/4W 5% film. 5 pieces each of 73 values. 365 pieces total. **\$3.95**

**MOTION DETECTOR**  
**\$2 ea. - 10 For \$15**



#### SOLDERING IRON 3-WIRE

**HIGH PERFORMANCE**  
 #060501 **\$5.25**



**SOLDERING IRON STAND**  
 W/SPONGE  
 #060842 **\$3.50**



**1 LB. 60/40 Solder Roll .031" \$5.95**

**DESOLDER PUMP**  
 W/TIP #060820 **\$3.50**

**15 TURN POT 7 SEG. DISPLAY**

69¢ ea. 60¢ ea.

Bourns 3006P series. All standard values available. MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

### FREE CATALOG

MORE  
 Low-Priced  
 Items In Our

**FREE**  
 216-Page Catalog



TERMS: Min. \$20 + shipping. School Purchase Orders, VISA/MC, Money Order, Prepaid. NO PERSONAL CHECKS, NO COD. NJ Residents: Add 6% Sales Tax.

In NJ: 732-381-8020  
 FAX: 732-381-1572

365 Blair Road • Avenel, NJ 07001-2293

**800-972-2225**

http://www.elexp.com  
 email: electron@elexp.com

CIRCLE 323 ON FREE INFORMATION CARD



# PARTS EXPRESS

ELECTRONICS & MORE

## 6-1/2" Two Way System

This is our most popular in-wall. You won't believe how good these really sound. Big enough to produce great home theatre sound and still fit everyone's budget. Put a pair in every room of your house.



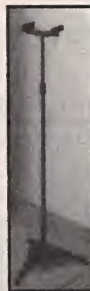
Great for front or rear speakers in your surround system. The 6-1/2" polypropylene woofer and 1" textile dome tweeter were specially designed with home theatre in mind. The crossover network utilizes a mylar capacitor for crisp clean highs. 3 piece design make installation in new or existing walls a snap.

**Specifications:** ♦6-1/2" polypropylene cone woofer with poly foam surround ♦1" textile dome tweeter/midrange ♦8 ohm impedance ♦3 component L/C crossover network ♦Frequency response: 50-20,000 Hz ♦Power handling capability: 60 watts RMS/85 watts max ♦Sensitivity: 89 dB 1W/1m ♦Overall dimensions: 8-1/2" W x 12" L x 3-1/2" D ♦Hole size: 7-1/4" x 10-3/4" ♦Fits into standard 2" x 4" wall ♦Net weight: 12 lbs. per pair.

#300-036 ..... \$89.90 (1-3 PRS) \$79.50 (4 PRS-UP)

## Satellite Speaker Stands

These quality speaker stands are perfect for mini or rear surround speakers. The heavy die cast base provides stability. Textured black satin finish blends in well with any decor. The height is adjustable from 26-1/2" to 47-1/2" and the speaker wire can be run inside the pole for a better appearance. The top base is adjustable from 4-1/8" to 7-1/2" to accommodate most mini speakers. Includes foam pads to prevent marring of speaker cabinet. Sold in pairs. Net weight: 12 lbs.



#240-762 ..... \$39.80 (1-3 PRS) \$35.50 (4 PRS-UP)

## 5 Function Remote

♦Operates five devices (TV, VCR, Cable, Satellite, A/V Receiver)  
♦Lighted component keys which indicate what device is currently being used ♦Preprogrammed, 621 codes that work over 6,400 models ♦New ergonomic design features a contoured case, index finger grooves, and keys grouped in clusters for easy operation ♦Satellite cursor control is tailored for use with a Home Theatre system, keypad design allows movement through menus with ease ♦Retains codes when replacing batteries ♦New flat back design for easy operation ♦Money back guarantee ensures customer satisfaction ♦Toll free customer service number provides the customer with friendly, knowledgeable assistance ♦Requires 2 AAA batteries (#140-150 not included)



#180-806 ..... \$29.95 (1-3) \$26.95 (4-UP)

## 3M 3/4" Temflex™ 1700 Vinyl Electrical Tape

General purpose 7 mil electrical tape. UL listed and CSA approved. 3/4" x 60' rolls.



#350-052 ..... 75¢ (1-9) 59¢ (10-UP)

## Gold Plated A/V Cables

A super quality, "shielded" type cable. Two RCA cables for stereo (audio) signal from VCR to receiver/stereo TV and one low noise coaxial type cable for video.



Part #	Length	Price (1-9)	Price (10-UP)
180-120	3 ft.	\$4.25	\$3.95
180-118	6 ft.	4.90	4.50
180-121	12 ft.	8.95	7.95
180-124	20 ft.	12.75	11.50

If you haven't received a copy of our current 260 page catalog ... have one added to your order or give us a call and we will send one out to you immediately.



## 6-1/2" Round Coaxial System

Designed for the home and office, these 6-1/2" round in-walls are ideal for ceiling installations, or for use as rear channel surround speakers. Adding music to the kitchen, den, bath, or patio has never been easier! System features a weather resistant 6-1/2" treated paper cone with poly foam surround, coaxially mounted 1/2" polymer dome tweeter, and built-in crossover with a mylar capacitor in the tweeter feed. Retrofit design allows installation in both new and existing construction in just minutes. System includes removable steel mesh grills, built-in mounting bracket, hardware, and installation instructions.



**Specifications:** ♦Impedance: 8 ohms ♦Frequency response: 60-20,000 Hz ♦Power handling capability: 30 watts RMS/45 watts max. ♦Sensitivity: 89 dB 1W/1m ♦Dimensions: 9" round x 2-7/8" deep. ♦Net weight: 5 lbs. per pair.

#300-408 ..... \$69.95 (1-3 PRS) \$62.75 (4 PRS-UP)

## 3 Amp Power Supply

This fully regulated power supply is perfect for powering CBs, car radios, and other 12 VDC devices that draw up to 3 amps. Heavy duty steel housing with front mounted switch and binding posts. Short circuit and overload protection!



**Specifications:** ♦Output Voltage: 13.8 VDC (fixed) ♦Output Current: 3A (cont), 5 amps (surge) ♦Ripple Voltage: Less than 3mV at rated output ♦Input Voltage: 120 VAC, 60Hz ♦Dimensions: 5-1/2" x 3-1/2" x 6-1/2" ♦Weight: 5 lbs.

#120-530 ..... \$19.95 (1-3) \$18.50 (4-UP)

## DMM and LCR Meter

In addition to functions found in regular DMM's, this meter can also measure inductance in 5 ranges (4mH, 40mH, 400mH, 4H, 40H), capacitance in 5 ranges (4nF, 40nF, 400nF, 4uF, 400uF), frequency in 4 ranges (4KHz, 40KHz, 400KHz, 4MHz), TTL logic test, diode test and transistor hFE test. 5 AC/DC ranges up to 1000V (AC750V), 3 AC/DC current ranges up to 20A and 7 resistance ranges up to 4000 M ohms. Includes test leads, battery, spare fuse, and manual. Net weight: 1 lb.



#390-513 ..... \$85.90 EACH

## 2.5W Mini Audio Amplifier

This amp contains both pre-amplifier and power amplifier on a super small board measuring only 1-5/8"x1-1/4". Maximum output power is 2.5W into 4 ohms with 12VDC input power. No adjustments required. Short circuit protected.



#320-215 ..... \$9.95 EACH

## Weller WLC100 Soldering Station

The Weller WLC100 solder station is ideal for the professional, serious hobbyist, or kit builder who demands higher performance than usual of a standard iron, but without the high cost of an industrial unit. Power is adjustable from 5 to 40 watts. Includes 40 watt pencil iron. UL approved. Net weight: 1-3/4 lbs. Replacement sponge #372-119.



#372-120 ..... \$39.95 EACH

## "44" Solder

Kester "44" rosin core solder is designed for electronic and electrical work. It uses a fast acting, instant wetting, non-corrosive, and non-conductive flux for faster soldering and a strong, long lasting bond.



Part #	Alloy	Lead/Tin	Spool	Dia.	Price (1-3)	Price (4-UP)
370-080	60/40	1 lb.	.031"		\$8.50	\$7.95
370-090	60/40	1 lb.	.050"		8.50	7.95
370-098	60/40	4 lb.	.031"		33.90	31.80
370-088	60/40	1/2 lb.	.020"		6.95	5.75
370-072	63/37	1 lb.	.020"		14.90	13.50
370-086	63/37	1/2 lb.	.031"		9.95	8.50
370-074	63/37	1 lb.	.031"		12.50	11.50
370-087	36/37	1/2 lb.	.031"		7.95	6.75

## Pro Wick

Pro Wick's advanced fine braid design provides wicking action that is second to none.



Part #	TS #	Size	Length	Price (1-9)	Price (10-UP)
341-415	1802-5	.06"	5'	\$1.40	\$1.25
341-416	1803-5	.08"	5'	1.45	1.30
341-417	1804-5	.10"	5'	1.60	1.45
341-424	1802-10	.06"	10'	2.75	2.50
341-425	1803-10	.08"	10'	2.80	2.55
341-426	1804-10	.10"	10'	2.95	2.70
341-440	1802-25F	.06"	25'	6.80	6.30
341-441	1803-25F	.08"	25'	6.85	6.35
341-442	1804-25F	.10"	25'	7.60	7.00
341-418	1802-100	.06"	100'	21.90	20.50
341-419	1803-100	.08"	100'	21.90	20.50
341-423	1804-100	.10"	100'	23.90	22.50

725 Pleasant Valley Dr., Springboro, OH 45066-1158  
Phone: 513-743-3000 ♦ Fax: 513-743-1677  
E-mail: sales@parts-express.com

KEY CODE: ENMI

LARGEST SELECTION OF SPEAKER DRIVERS IN THE COUNTRY!

VISIT OUR WEB SITE AT  
**www.parts-express.com**

OR CALL TOLL FREE  
**1-800-338-0531**



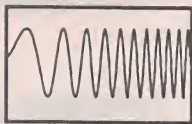
# Any waveform you want!



## New Features:

- ✓ 21.5 MHz
- ✓ .01 Hz steps
- ✓ multi-unit phaselock

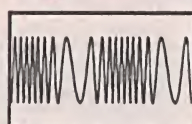
### Telulex Inc. model SG-100A



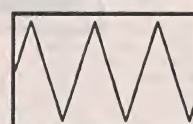
DC to 21.5 MHz linear and log sweeps



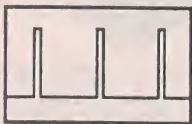
Int/Ext AM, SSB, Dualtone Gen.



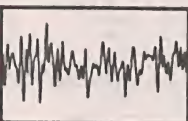
Int/Ext FM, PM, BPSK, Burst



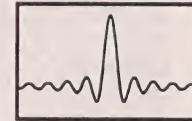
Ramps, Triangles, Exponentials



Pulse Generator



Noise



Arbitrary Waveforms



Unlimited Possibilities!

**Telulex Inc.**

2455 Old Middlefield Way S Tel (650) 938-0240 <http://www.Telulex.com>  
Mountain View, CA 94043 Fax (650) 938-0241 Email: [sales@Telulex.com](mailto:sales@Telulex.com)

CIRCLE 312 ON FREE INFORMATION CARD

[www.unbound-tech.com](http://www.unbound-tech.com)

**UTI 1-877-UNBOUND**

Development Boards, Microcontrollers, Kits,  
Control and Measurement

#### Development, Prototype and Testing

- JCM Vulcan Logic Trainer: Design and test digital circuits in minutes with this trainer and a breadboard. \$32
- JCM Advanced dig daughterboard \$39
- JCM Analog Trainer: Use on its own, or to complement to the logic trainer, test analog circuits in minutes. \$45
- UTI PIC-Micro Trainer: This system gives you the flexibility to test and experiment with micro based designs, includes a 64K-bit non-volatile E<sup>2</sup> mem, and RS-232 and RS-485 drivers. \$129
- UTI Control Trainer: Real world interface for the trainer series, with inputs and outputs for measurement and control, analog cond, relays, buffered dig I/O, and more. \$69
- JCM Cybug1 kit, a great little robot kit for the hobbyist \$32
- Prototyping breadboard to fit the above

#### Microcontroller Boards and Interfaces

- These boards include voltage regulation, 64K-bit serial E<sup>2</sup>, RS-232 and RS-485 drivers, interface with screw terminals and/or stackable expansion headers.
- UTI-P76F: A flash PIC micro dev board \$169
  - UTI-11A1: A 68HC11 based SBC \$189
  - Some interfaces available: \$49-\$99
    - 4 and 8 channel analog zero and span cct
    - 8 SPDT relays with 2A contacts
    - 2A dual H-bridge for motors and solenoids
    - Audio capture, 2-4 min of audio
    - Micro modem rates @ 2400 - 28.8
    - LCD, 2 line x 16 char, and 4 line x 20 char
    - Ambient temperature and relative humidity
  - UTI-12CM-XXX-X: Non-volatile I<sup>2</sup>C memory boards (up to 512Kb per board) \$39

#### Serial Control and Measurement

- UTI-XX-232.485 Series: measure inputs and trigger events over serial, uses simple ASCII protocol \$99-\$299
  - UTI-05-XXX: 0-5VDC 4 channel 8 bit A/D
  - UTI-DI-XXX: 0-30VDC 4 channel digital input adjustable trigger level
  - UTI-OC-XXX: 8 channel open collector outputs, opt 5V pull-up, drive relays or solenoids
  - UTI-RE-XXX: 4 SPDT relays w/ 2A contacts
  - UTI-PM-XXX: 2 channel PWM output with two buffered digital outputs, good for motor control apps, opt H-bridge version.
  - UTI-WM-XXX: ambient temperature and relative humidity, 8 bit resolution
  - More available....
- UTI-232-485: Speak to an RS-485 device with your PC, extend 500' to other serial devices, or chain several UTI-XX-485 devices. \$129

#### Other Exciting Products

- UTI-WC1: Serial CCD Camera. Board level, takes serial commands through RS-232 at up to 115K Baud, returns CCD data in various res. Great for pics and experimenting. PC SW incl. \$249
- UTI-SCL: WinCam.Live. Serial port based webcam system for your PC. \$499
- UTI-SCP: SecureCam Pro. Remote access surveillance camera, event trigger, motion detection, outdoor encl. available \$599
- UTI-ACC: Capture and play 2-4 min of audio, line level input, dry contact trigger \$129
- UTI-MP-XXX: serial RS232 radios, 900MHz narrow band RF, ch selectable, 1000' range outdoor, combine with our control and measurement products for a telemetry system. \$519

\* All prices in US\$

\*\*Shipping and handling not included

We also provide affordable electronic design, consulting, assembly, and product development.



**UTI**  
Unbound  
Technologies Inc.  
1-877-UNBOUND  
(1-877-862-6863)

#25-1725 30 Ave NE Calgary, Alberta, CANADA T2E 7P6  
Tel: 403-291-0054 Fax: 403-291-0017  
Payment by Cash, Chk, MO, COD  
Call us to receive details via fax, mail or email.

## PIC'n Books

### LEARN ABOUT PIC MICROCONTROLLERS

EASY PIC'n - Beginner \$29.95

PIC'n Up The Pace - Intermediate \$34.95

**NEW!**

PIC'n Techniques - Intermediate \$34.95

- 8-pin PICs
- Timer 1, timer 2 and the capture/compare/PWM (CCP) module
- Talking to a PIC with a PC using a terminal program
- Test equipment and data logger experiments

See Table Of Contents: <http://www.sq-1.com>  
Secure Online Ordering is Available

+ \$4 s/h in US for 1 book, \$5 for 2 books, \$6 for 3 books  
VISA, MC, AMEX, MO, Check

CA residents please add 7.25% CA sales tax  
PIC and MPLAB are trademarks of Microchip Technology Inc.

**SQUARE 1 ELECTRONICS**

P.O. Box 501, Kelseyville, CA 95451  
Voice (707) 279-8881 FAX (707) 279-8883  
Web Site: <http://www.sq-1.com>  
E-Mail: [sqone@pacific.net](mailto:sqone@pacific.net)



# IS ANYBODY OUT THERE?

## NEW, 2.4GHZ VIDEO + STEREO AUDIO TRANSMITTER with SONY, CCM-PC5 COLOR CAMERA.

Originally sold for \$500! Now available for a fraction of that price. Great looking styling. Camera has a very stable, adjustable tilting base, front panel LED pwr. indicator and sensitive built in electret mic, providing excellent audio and video performance from one compact package. Simply connect camera to the completely self contained 2.4GHz transmitter. All cables supplied. You can transmit up to 700 feet clear line of sight! Companion matching receiver works with any TV or VCR. Internal patch antennas. Camera has adjustable focus 6mm lens. (1" to infinity, macro capable) Auto power off when the privacy shutter is closed. Power is 7-13VDC. (all pwr. adapters and cables included) 1/3" CCD, 330Lines res. 35% better than standard VHS! Can also be used to transmit VCR output to another TV. **SPECIAL 2.4GHz SONY-ASTROVIEW.... \$189ea. or 2 for \$339**  
**2.4GHz TRANSMITTER & RCVR. only less camera..... \$129**



## NOW YOU CAN SEE WHAT THE "FISHES ARE DOIN' " GO UNDERWATER (to 60 ft.) Waterproof B&W CAMERA & INTERNAL, INFRA-RED ILLUMINATOR!



Sleek black anodized, BRASS, housing is O-Ring sealed & WATERPROOF. Adjustable mount included. Specs: 1/3" CCD, 400 Lines resolution, 0.05 Lux sensitivity, AGC, Auto Shutter. Operates on 12VDC @225mA, 4mm, 78° FOV lens, A real glass lens. NTSC video out. Superior construction. SENSITIVE to IR. Ultra small Size only: 1.25" diam. X 2" long. With 60 ft. cable. Great for general outdoor use also. **REG. \$299, GM-300KIR.....\$219**

## CHECK THIS! ULTRA MINI, WEATHERPROOF, COLOR too!



NEW "COLOR LIPSTICK" camera. For those applications that must be color, this is it. Black anodized, aluminum, housing is O-Ring sealed & RAINPROOF. Adjustable tilting mount included. Specs: 1/3" CCD, 400 Lines resolution, <1 Lux sensitivity, AGC, Auto Shutter. 12VDC @180mA, 4.3mm, 78° FOV lens, A real glass lens. Std. video out. Size: 32mm diam. X 65mm long. 24" leads with RCA jack and DC jack. Ready to go!

**SPECIAL this MONTH, GM-400K...\$249, pwr. adpt...\$4.95**

## C-MOUNT LENS OPTIONS to ENHANCE YOUR IMAGE:

Fast Lenses for Low Light or General Purpose Normal Light

16mm, f1.6, 15° FOV .....	\$39	4mm, 80° FOV .....	\$24
8mm, f1.3, 40° FOV .....	\$49	8mm, 40° FOV .....	\$24
4mm, f1.4, 78° FOV .....	\$49	12mm, 28° FOV .....	\$24

## 6V@12AH SEALED, RECHARGEABLE, BATTERY

New Panasonic, LCR6V12PL. Tough to get at a discount. Very compact. Two top mounted 1/4" faston connectors. Perfect for high drain projects. Size: 5.9" L x 3.7" H x 1.9" D  
**2 for \$20, or 10 for \$89**



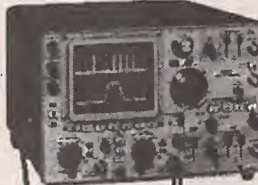
**10V @ 2.5 AH SEALED, LEAD ACID, PACK** Each pack consists of five, 2 Volt cells. Each cell the size of a std. 'D' battery. Arranged as 1X5 cells. Enclosed in an ABS outer shell. (removed for photo) Mint condition. Perfect for high drain and robotics applications. Make custom packs of any rating. Size: 7.5" L x 2.8" H x 1.5" D **5-five packs ....\$20, 30 for \$99**



## 350MHz, TEK 485,

A superior performing O'scope, Dual Trace, Delayed sweep 1 nS/div Sweep rate, 5mV Vert. sensitivity. Switchable input Imped., 50 ohm / 1meg. Package Includes 2 probes, cover and operation manual.

**ORIG., \$9100ea. SPECIAL.....\$795**



## NEW, "STEALTH CAM", MICRO, with AUDIO!

The sleek aluminum housing fits like a glove! Removeable mounting bracket and a 1.3M cable with BNC vid., RCA aud., (internal mic) & DC barrel jack for, no sweat hook up. Why fool around with an open P.C. board? Now you can have the "STEALTH CAM". 1/3" CCD, 410 Lines, 0.3 Lux, AGC, Auto Shutter. Pwr. from 9 to 12VDC @110mA, 250k pixels, Std. model, 4mm, 78° FOV lens, Pinhole model, 90° FOV. A real glass lens. Focus from 10mm to infinity. NTSC video out. Only 1.7 ounce! SENSITIVE to IR. Size Std: 30mm sq. x 29mm d. PH is 16mm d. **WARNING: Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS. GM-2000S-STD or Pinhole, w/audio.....\$79ea.**



## DOVER AIR BEARING X/Y TABLES, ULTRA PRECISE,

Like New, The ultimate in precision motion. These are leadscrew operated air bearing tables with 1-20 Microns typ. repeatability. Straightness, <1 micron each axis, angular error, <1 arc/sec. Squareness, <5 arc/sec. Three models available. Model "A" has 6"x6" travel with 2 type 23BLS-021-02, 4.85A 24V Rapidsyn stepper/encoders. Type "B" is as above without motors. Type "C" has 4"x5" travel with two Compumotor LE57-51-MTR steppers. No controllers. **TYPE "A"...\$1200, TYPE "B"...\$949, TYPE "C"...\$849**



## NEW! 0.008lux, COLOR NIGHT VISION CAMERA! UNBELIEVABLE LOW LIGHT PERFORMANCE.

**Our GMV-2K, DOES it in COLOR TOO!**



For covert, military and scientific applications that must be color, this is it. Performance is enhanced through low speed electronic shuttering and digital frame memory. With an auto iris lens, 24 hour monitoring is possible. Auto sensitivity mode starts as it becomes dark. Eight Gain/Shutter modes are user selectable. Normal, X4, X8, X16, X24, X32, X64, X128. These provide frame rates of 60, 15, 8, 4, 3, 2, 1, and 0.5 frames per second. Auto/Manual white balance. Aluminum housing with dual 1/4x20 mounts. Specs: 1/3" CCD, with 291K pixels, 320 Lines, <1 Lux std. mode sens., 12VDC @200mA, Std. video out on BNC. Size: 54mmx50mmx94mm long. With pwr. adapter. All functions can be externally controlled via an 8 pin mini DIN. Uses std. c-mount lens not included. **Special Item, GMV2K.....\$589ea.**

**4mm, f1.4 A/I lens with custom cable.....\$ 99ea.**

## NEW! DAYLIGHT to LOW LIGHT MINI CAM, w A/I LENS

For those applications that must work from dawn 'till dusk, this is it. Rugged aluminum housing with dual mounting sockets. Specs: 1/3" CCD, 420 lines resolution, 0.1 Lux sens., AGC, Auto shutter. 12VDC @120mA. Take full advantage of camera sensitivity with the super, 4mm, f1.4, 78° FOV Auto Iris lens included. Video out on BNC. Size: 50mm sq. X 65mm long. Pwr. adpt. incl. Ready to go! **SUPER SPECIAL GM-510-A/I...\$199ea. or 2 for...\$369**



*Please fax us your list of unique surplus material.*

## ULTRA MINI and WEATHERPROOF, "LIPSTICK" CAMERA

Sleek black anodized, alum. housing, O-Ring sealed & RAINPROOF. Adj. tilting mount. 1/3" CCD, 380 Lines, 0.3 Lux, AGC, Auto Shutter. 9-12VDC @100mA, 4mm, f1.8, 78° FOV real glass lens, NTSC video. <1ounce! IR SENSITIVE. 23mmdX50mm, 36" cable with BNC video & DC barrel jack. PINHOLE Model. So tiny you can install it directly into a door. Only a 0.9" diameter hole! Specs as above. 90° FOV Pinhole lens. 1/2 ounce! Size only 23mm d.x35mm long. Think of the places you could put this little jewel. **GM-200K-STD...\$119 or GM-200K-PH lens...\$119**



# RESOURCES UNLIMITED

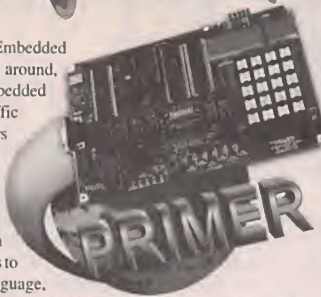
300 BEDFORD STREET, MANCHESTER, NH 03101

VISA, MC, AMEX, DISCOVER, COD. ORDER: 800-810-4070 TECH. 603-668-2499 ORDER FAX: 603-644-7825 E-MAIL unld@thac.net



# World Passing You By?

Are you interested in Microprocessors & Embedded Control Systems? If not you should be! Look around, just about everything these days has an embedded microprocessor in it. TVs, cars, radios, traffic lights & even toys have embedded computers controlling their actions. The Primer Trainer is the tool that can not only teach you how these devices operate but give you the opportunity to program these types of systems yourself. Examples & exercises in the Self Instruction manual take you from writing simple programs to controlling motors. Start out in Machine language, then move on to Assembler, & then continue on with optional C, Basic, or Forth Compilers. So don't be left behind; this is information you need to know!



## Examples Include:

- Measuring Temperature
- Using a Photocell to Detect Light Levels
- Making a Waveform Generator
- Constructing a Capacitance Meter
- Motor Speed Control Using Back EMF
- Interfacing and Controlling Stepper Motors
- Scanning Keypads and Writing to LCD/LED Displays
- Bus Interfacing an 8255 PPI
- Using the Primer as an EPROM Programmer
- DTMF Autodialer & Remote Controller (New!)

The PRIMER is only \$119.95 in kit form. The PRIMER Assembled & Tested is \$169.95. This trainer can be used stand alone via the keypad and display or connected to a PC with the optional upgrade (\$49.95). The Upgrade includes: an RS232 serial port & cable, 32K of battery backed RAM, & Assembler/Terminal software. Please add \$5.00 for shipping within the U.S. Picture shown with upgrade option and optional heavy-duty keypad (\$29.95) installed. Satisfaction guaranteed.

# EMAC, inc.

11 EMAC WAY, CARBONDALE, IL 62901  
618-529-4525 Fax 457-0110 BBS 529-5708  
World Wide Web: <http://www.emacinc.com>

1985 - 1998  
OVER  
**12**  
YEARS  
OF SERVICE

Whaddya Say To  
A Guy Who's Had  
The Same Job  
For 50 Years,  
Has Never Called  
In Sick Or  
Showed Up Late,  
Never Taken A  
Vacation Or A  
Holiday, Never  
Asked For A  
Raise Or Griped  
About His Bonus  
And, Believe It Or  
Not, Has No  
Plans For  
Retirement?



Thanks.

Remember - only you can prevent forest fires.

## MEMBRANE SWITCHES



**Stock Layouts!**

**Eliminates tooling cost...**

**\*\*From 2 to 128 keys\*\***

**Industrial/Commercial/Prototyping**

Popular types are available as complete **kits**, with bezel, connector & overlay!

4 key DSK-4 kit **\$9.60**

12 key DSK-12 kit **\$13.87**  
many more layouts...

**Optional Stainless Steel "Clickdomes".**

## Sil-Walker

(805) 491-0654

FAX (805) 491-2212

P.O. Box 3220

Camarillo, CA 93011-3220

[silwkr@vcnet.com](mailto:silwkr@vcnet.com)

[www.vcnet.com/silwkr/](http://www.vcnet.com/silwkr/)

MASTERCARD/VISA

## ATTENTION DEALERS: WHOLESALE ONLY!



**BEST PRICES!  
FAST SERVICE  
SAME DAY SHIPPING**

**EXCLUSIVE:**



**2 PIECE SETUPS: \$85<sup>00</sup>**

10 lot • 1 Year Warranty

**Latest Technology • Universal Combo's - Ask For Details  
CALL US LAST! LOWEST PRICES GUARANTEED!**

**TOLL FREE:  
800-375-3682**



**FAX:  
516-246-5634**

**Max '99' \$459.90**

Used world wide for research!



- Three 12 inch diameter decks
- 30 lbs payload capacity
- HC11 microprocessor w/ 32k ram
- Basic, Forth and 'C' programming lang.

Zagros Robotics  
PO Box 460342  
St. Louis, MO 63146-7342  
(314)768-1328  
<http://www.zagrosrobotics.com>  
[info@zagrosrobotics.com](mailto:info@zagrosrobotics.com)

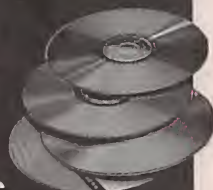


# A Trained Computer Repairman Charges \$100 An Hour and More... You Can Get That Training!

Foley-Belsaw's Totally New  
Computer Repair Course  
gives you the skills to  
start earning top pay  
**FAST!!!!!!**

You get these Foley-Belsaw  
Exclusives! At no extra cost!

- A+ Certification Test Preparation Tutor™
- Foley-Belsaw CD-ROM Learning Assistant™
- Business Start-up Resource



## SPECIAL BONUS

Inquire now and your course will come with a complete video archive library of early printer and computer repair techniques... at no additional cost.



**No Experience  
Necessary!**

Get "hands-on" training in the exciting field of computer repair.

## Train At Home!

There's not a more complete—or affordable—PC Repair course that will have you trained and job ready in such a short time.

**Take the first step to top pay.  
Call for a FREE Opportunity Kit today!  
1-800-487-2100**

**Fully illustrated, easy to understand course gives you everything you need to succeed.**

The key to your success lies in providing a service that is in great demand. Even if you have no experience, you can become an expert in a few short months. Foley-Belsaw's computer repair course is broken into small, easy to manage lessons. Each lesson is designed with your success in mind. After you complete the course, you'll have the expert knowledge to earn up to \$100 an hour, or more!

**Latest technologies and insider knowledge available only to Foley-Belsaw students!**

Get the "hands-on" experience you need in Computer Repair. Foley-Belsaw's CD-Rom Learning Assistant™ guides you through each lesson and is always right at your fingertips. The Test Preparation Tutor™ makes preparing for your A+ Certification as easy as turning on your computer. Foley-Belsaw's inside knowledge gives you the practical experience to become a computer repair professional. Get started today!

or complete this coupon and mail to Foley-Belsaw Institute, 6301 Equitable Road, Kansas City, MO 64120-1395

☐ **Yes!** Send me one of the following Free Opportunity Kits:

- ☐ Computer Repair, Maintenance, Upgrade, Dept. 64844
- ☐ Personal Computer, Specialist, Dept. 38471
- ☐ Professional Computer Programming, Dept. 35653
- ☐ Professional Saw and Tool Sharpening, Dept. 22038
- ☐ VCR/DVD Service and Repair, Dept. 62935
- ☐ Small Engine Service and Repair, Dept. 53107
- ☐ TV/Satellite Dish Service and Repair, Dept. 31706
- ☐ Professional Gunsmithing, Dept. 92747
- ☐ Home Inspection, Dept. 76147
- ☐ Networking Specialist, Dept. 39458
- ☐ Locksmithing, Dept. 13236
- ☐ Woodworking, Dept. 43970
- ☐ Upholstery, Dept. 81642
- ☐ Vinyl Repair, Dept. 71549
- ☐ Electrician, 95514

**Satisfaction  
Guaranteed**  
Foley-Belsaw gives you  
a Free 30-Day Trial.  
*Be careful!*  
Most schools charge \$150.00  
for this privilege.

Name \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

Zip \_\_\_\_\_

Phone ( ) \_\_\_\_\_



World leader in training since 1926, provides at-home, "hands-on" training in high-demand fields.

CIRCLE 335 ON FREE INFORMATION CARD

PC  
PLACE

June 1999, Electronics Now

59



# Home Automation

- World's Largest Selection!
- Best Customer Service
- Top Technical Support



**FREE**  
160 page full  
color catalog!

Dealers/Resellers ask about our  
SmartHome PRO Dealer Program 800-949-6255

Take a step into the future --  
discover the latest in innovative  
home technology, from remote  
controls to high-tech toys to  
voice-activated systems. We will  
show you the *smart* (and easy!)  
way to automate your home.

**Lowest Prices Guaranteed!**

Call **800-SMART-HOME**  
800-762-7846

or visit us on the web @  
**smarthome.com**  
to order your **FREE** catalog today!

**Order 24 Hours • 7 Days**

**HOME AUTOMATION  
SYSTEMS, INC.**



## EPROM+

A device programming system  
for design, repair and experimentation

- ♦ **EXCEPTIONAL POWER FOR THE PRO**
- ♦ **EASY-TO-USE FOR THE NOVICE**
- ♦ **INCLUDES STEP-BY-STEP TUTORIAL**

**Here's what you get:** A rugged, portable programming unit including the power pack and printer port cable both of which store inside the case. A real printed user and technical manual which includes schematic diagrams for the programming unit plus diagrams for all technology family adapters.\* Comprehensive, easy-to-use software which is specifically designed to run under DOS, Windows 3.1, 95 and 98 on any speed machine. The software has features which let you **READ, PROGRAM, COPY and COMPARE** plus much more. You have full access to your system's disk including **LOADING and SAVING** chip data plus automatic processing of **INTEL HEX, MOTOROLA S-RECORD and BINARY** files. For detailed work the system software provides a full screen buffer editor including a comprehensive bit and byte tool kit with more than 20 functions.

**Broad device support:** FIRST GENERATION EPROMS (2708, TMS2716\*, 25XX) SECOND GENERATION EPROMS (2716-28C080), 40 AND 42 PIN EPROMS\* (27C1024-27C160) FLASH EPROMS (28F29C, 29EE, 29F), EEPROMS (2816-28C010), NVRAMS (12XX.X2210/12) 8 PIN SERIAL EPROMS\* (24, 25, 85, 93, 95, 8001A) PLUS ER1400/M5865\* AND ER5901 BIPOLAR PROMS\* (72S/82S), FPGA CONFIGURATORS (17CXXX) MICROCONTROLLERS\* (874X, 875X, 87C5XX, 87C75X, 89C5X) ATMEL MICROS\* (8400 PIN 89C051, 89SXXX (AVR) 90SXXX PIC MICROS\* (8, 18, 28, 40 PIN (12CXX-16CXXX, 16FXX, 17C) MOTOROLA MICROS\* (68705P3/J3/R3, 68HC705, 68HC711)

**\$289**

\*REQUIRES SNAP-IN ADAPTER (ORDER FACTORY DIRECT OR BUILD YOURSELF) \$5.00 SHIPPING • \$5.00 C.O.D.  
1 YEAR WARRANTY - 30 DAY MONEY BACK GUARANTEE VISA • MASTERCARD • AMEX

**ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OH 45150**  
(513) 831-9708 FAX (513) 831-7562 website - [www.arlabs.com](http://www.arlabs.com)

## Turn Your Multimedia PC into a Powerful Real-Time Audio Spectrum Analyzer

### Features

- 20 kHz real-time bandwidth
- Fast 32 bit executable
- Dual channel analysis
- High Resolution FFT
- Octave Analysis
- THD, THD+N, SNR measurements
- Signal Generation
- Triggering, Decimation
- Transfer Functions, Coherence
- Time Series, Spectrum Phase, and 3-D Surface plots
- Real-Time Recording and Post-Processing modes

### Applications

- Distortion Analysis
- Frequency Response Testing
- Vibration Measurements
- Acoustic Research

### System Requirements

- 486 CPU or greater
- 8 MB RAM minimum
- Win. 95, NT, or Win. 3.1 + Win.32s
- Mouse and Math coprocessor
- 16 bit sound card



**Priced from \$299**

(U.S. sales only - not for export/resale)

**DOWNLOAD FREE 30 DAY TRIAL!**

[www.spectraplus.com](http://www.spectraplus.com)

**PHS**

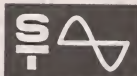
Pioneer Hill Software  
24460 Mason Rd.  
Poulsbo, WA 98370

a subsidiary of Sound Technology, Inc.

Sales: (360) 697-3472

Fax: (360) 697-7717

e-mail: [pioneer@telebyte.com](mailto:pioneer@telebyte.com)



**Spectra Plus**  
FFT Spectral Analysis System

### Data Acquisition and Control

The ADR series of Interfaces allow control of analog, digital and relay I/O via RS232 or RS485. Visit the web site for specs, applications and programs in VB, C, BASIC etc. (705) 671-2652

[www.ontrak.net](http://www.ontrak.net)

**Ontrak Control Systems Inc.**

**POPTRONIX®**

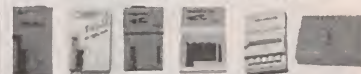
**Awaiting your call!**

**Online Edition**

<http://www.poptronix.com>

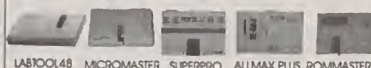
## PROGRAMMERS OVER 50 MODELS

ADVANTECH EETOOLS NEEDHAMS DATA VO ICE TECHNOLOGY HILLO SYSTEM GENERAL CHROMA MODULAR CIRCUIT TECHNOLOGY XELTEK



PROMAX EMP-20 MEGAMAX MEGAMAX4 SIMM/SP TESTER EMUPA

CALL ADVANTECH LAB700L	599 EETOOLS SIMMAX
629 ICE TECH MICROV	795 CHROMA SIMM/SIP
650 EETOOLS ALLMAX +	359 MOD-MCT-EMUPA/R
409 EETOOLS MEGAMAX	279 MOD-MCT-EMUPA/R
509 EETOOLS MEGAMAX4	49 EPROM 1G TO 512K
369 XELTEK SUPERPRO II	69 EPROM 1G TO 1MEG
409 XELTEK SUPERPRO II P	99 EPROM 4G TO 1MEG
249 XELTEK SUPERPRO L	199 EPROM 16G TO 1MEG
165 XELTEK ROMMASTER II	89 EPROM 1G TO 8MEG
479 MOD-MCT-EMUPA	129 EPROM 4G TO 8MEG
739 STAG ORBIT-32	250 EPROM 8G TO 8MEG



LAB700L48 MICROMASTER SUPERPRO ALLMAX PLUS ROMMASTER2

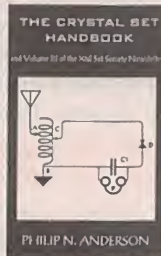
### General Device Instruments

Sales 916-393-1655 Fax 916-393-4949 BBS 983-1234

Web [www.generaldevice.com](http://www.generaldevice.com) E-Mail [icdevice@best.com](mailto:icdevice@best.com)

## INSIDE CRYSTAL SETS

An easy-to-read book on crystal set theory and construction opens vistas for novices and pros alike. Build radios like Grandpa did, do it better, and know what you are doing. The *Crystal Set Handbook*, published by The Crystal Set Society, is an authentic guide on the topic.



To order *The Crystal Set Handbook*, send \$10.95 plus \$4.00 for shipping in the U.S. and Canada only to **Electronics Technology Today Inc.**, P.O. Box 240, Massapequa Park, NY 11762-0240. Payment in U.S. funds by U.S. bank check or International Money Order. Please allow 6-8 weeks for delivery.

MA03



## Electronic CAD for Windows

Professional Windows EDA tools at an affordable price with powerful features to make designing faster. WinBoard PCB layout delivers sophisticated interactive routing for complex designs, plus it has the tools needed for high-speed circuits, analog, RF and SMT designs.

### WinDraft® Schematics

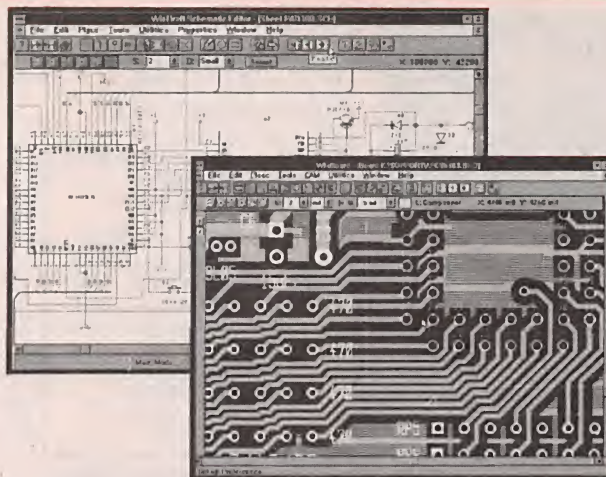
- ◆ Use True-Type fonts. Quickly copy and paste into other applications.
- ◆ Supports hierarchical designs, electrical rules checking, Annotation & Bill of Materials.
- ◆ Thousands of library parts and symbol editor included.

### WinBoard™ PCB layout

- ◆ Supports 16 layers, multiple copper pours, and advanced features for RF designs.
- ◆ SMD & through hole library with on-line graphical editor.
- ◆ CAM outputs include BOM, in-circuit test, NC Drill, Gerber, Pick & Place, & Advanced Design Rule Checking (DRC).

With our unique **pin capacity** versions you only pay for what you need. You choose the base configuration to suit your needs today, and expand that configuration to handle increased pin capacity as your design requirements change.

**WinDraft 2.0 Available Now**



**\$ 250** WinDraft or WinBoard - P650  
**\$ 495** WinDraft or WinBoard - unlimited

**\$ 895** WinBoard P650 with CCT  
 Spectra® autorouter.

Thousands of satisfied customers are using this new generation of powerful and affordable Windows EDA tools from Ivex. Your satisfaction is guaranteed!

**World Wide Web: <http://www.ivex.com>**

Information and free evaluation version is available on the Ivex WW Web, FTP and BBS.

**Tel: (503) 531-3555**  
**Fax: (503) 629-4907**  
**BBS: (503) 645-0576**



Ivex Design International. 15232 NW Greenbrier Parkway. Beaverton, Oregon 97006. USA.

ADV2\_1

CIRCLE 319 ON FREE INFORMATION CARD

## Precious Life

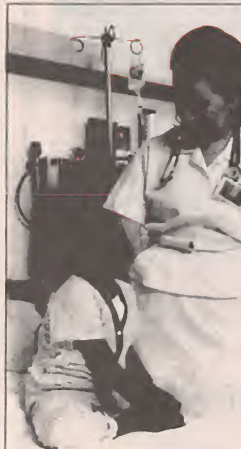
Not too many years ago, this nurse was a patient at St. Jude Children's Research Hospital. She fought a tough battle with childhood cancer. And won.

Until *every* child can be saved, our scientists and doctors must continue their research.

To find out how you can help, call 1-800-877-5833.



**ST. JUDE CHILDREN'S  
 RESEARCH HOSPITAL**  
 Danny Thomas, Founder



## Carpet Rover Kit

**\$115.00 Plus S&H**



**You can build this Mobile Robot**

This easy to build mobile robot base is an excellent foundation for many different robotic experiments. The large 3" wheels handle rough terrain. Use the robot for demonstrating bumper switch or IR obstacle avoidance, maze negotiation, line following, light following, beacon locating, robot sumo, and robot art, to name a few. The kit includes the hardware, structural components, Hitec servos, wheels, First Step micro, software, and an illustrated assembly manual. It's a lot of fun to build and even more fun to operate.



Shown with the IRPD, no contact obstacle detector.

**We have many more cool robots, check out our web page or ask for our free catalog!**

**Lynxmotion, Inc.**  
 104 Partridge Road  
 Pekin, IL 61554-1403  
[www.lynxmotion.com](http://www.lynxmotion.com)



Tel: 309-382-1816  
 Fax: 309-382-1254  
[sales@lynxmotion.com](mailto:sales@lynxmotion.com)  
[tech@lynxmotion.com](mailto:tech@lynxmotion.com)



# 386 MINI-PC \$83

1K PRICE  
EVAL \$295  
8088 \$27



includes:  
-5 Serial,3 Parallel (32bit max)  
-Up to 8 meg ROM (27C080)  
-32k RAM exp. to 64Mbyte  
-Battery backed RT Clock  
-LCD and Keyboard ports  
-IRQ x15, DMA x2, TIMER x4  
-On-board LED display  
-Industry Standard PC Bus

Perfect when a full-size PC is too large, expensive, or power hungry. A fully functional single board computer, needs only program and power source. Runs DOS / WINDOWS. Use Turbo C, BASIC, MASM. All utilities to do this included.

## A to D D to A CONVERTERS

For PC or SBC  
8,12,16 bit resolution  
up to 24 channels  
starting at \$21 OEM (1k)  
eval kit \$75

## \$95 UNIVERSAL PROGRAMMER

FLASH, EEPROM, NVRAM, EPROM  
up to 8 meg (27C64-080). Adapters for  
micros, PLCC, etc. Parallel port version  
for notebook. FAST AND EASY TO USE.



LOW COST... LOW POWER...

## LOW RISC!

QTY 1K PRICE  
\$1.99  
EVAL KIT 7.00

LOWER COST, FASTER, EASIER TO PROGRAM SINGLE CHIP COMPUTER

COMPARE:	16C54	MV1200	PINOUT:
OEM (1K) PRICE	\$2.57	\$1.99	
RS232 PROGRAM DOWNLOAD	NO	YES	RESET 1 20 VCC
SINGLE CHIP OPERATION	NO	YES	PD0 2 19 PB7
BUILT-IN BASIC	NO	YES	PD1 3 18 PB6
EEPROM DATA MEMORY	NONE	64	XOUT 4 17 PB5
PROGRAM MEMORY	768 OTP	1K FLASH	XIN 5 16 PB4
MATH REGISTERS	1	32	PD2/INT 6 15 PB3
MAX INSTRUCTIONS / SEC	5M	20M	PD3 7 14 PB2
MAX COUNTER BITS	16	18	PD4/TMR 8 13 PB1/AD1
INPUT / OUTPUT BITS	12	15	PD5 9 12 PB0/AD0
A TO D COMPARATOR	NO	YES	GND 10 11 PD6
HARDWARE INTERRUPTS	NONE	3	
- LONG WORD INSTRUCTION - FRIENDLY SYMMETRIC ARCHITECTURE -			



**PC SOLID STATE DISK**  
\$21 OEM (1k) eval kit 75.00  
FLASH / RAM / EPROM  
256K-16M PCMCIA/DIPS

No More Hangups...

**PC WATCHDOG!**  
Reboots PC OEM \$21 EVAL \$75



**VGA LCD** 640x480 controller  
for PC or SBC  
\$27 oem \$95 eval  
combo LCD/CRT  
version available



visit our web site: [www.mvsweb.com](http://www.mvsweb.com)

MVS BOX 850  
MERRIMACK, NH 03054  
(508) 792-9507

**MVS**

5yr Limited Warranty  
Free Shipping  
Hrs: Mon-Fri 10-6 EST

## DATA ACQUISITION & CONTROL

AFFORDABLE PLUG-IN BOARDS FOR PC's ISA BUS

ANA100 Analog I/O ..... \$ 99



\* 8 Channel 8-Bit  
\* 0 to 5 Volt Input  
\* 14 TTL I/O lines  
\* Analog Output  
\* 400KHz Sampling

DIG100 Digital I/O ..... \$ 39



\* 82C55 PPI  
\* 24 or 48 TTL I/O  
Lines option  
\* Selectable Base  
Address

ANA150 Analog/Counter... \$ 89



\* 8 Channel 8-Bit  
\* 0 to 5 Volt Input  
\* 3 16-Bit Counters  
\* 400KHz Sampling

DIG200 Counter I/O ..... \$ 79



\* 3 16-Bit Counters  
\* 8 TTL Input lines  
\* 8 TTL Output lines  
\* Selectable Clock  
Frequency Input

ANA200 Analog I/O ..... \$ 79



\* 1 Channel 12-Bit  
\* 0 to 5 Volt Input  
optional bi-polar  
\* 100KHz / 300KHz  
Sampling rate  
\* 24 TTL I/O lines

ANA240 Analog ..... \$ 119



\* 8 Channel 12-Bit  
\* x1, x5, x10, x50  
Programmable  
Channel gain  
\* 100KHz  
Sampling rate

On-Line Product Catalog at Our Web Site

<http://www.Bsof.com>

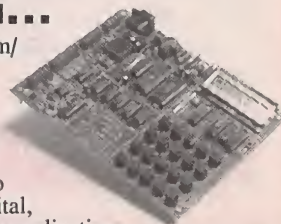
E-Mail: [Sales@Bsof.com](mailto:Sales@Bsof.com)

**BSOFT Software, Inc.**

444 COLTON ROAD \* COLUMBUS, OH 43207  
PHONE 614-491-0832 \* FAX 614-497-9971

## Learn MICROCONTROLLERS EMBEDDED SYSTEMS and PROGRAMMING...

...with the AES learning system/  
embedded control system.  
Extensive manuals guide you  
through your development  
project. All programming and  
hardware details explained.  
Complete schematics. Learn to  
program the LCD, keypad digital,  
analog, and serial I/O. for your applications.



**THREE MODELS AVAILABLE. Choose from an  
Intel 8051, Intel 8088, or Motorola 68HC11  
based system. All models come with:**

\* 32K Byte ROM, 32K Byte RAM • 2 by 16 Liquid Crystal Display • 4  
by 5 Keypad • Digital, Analog, and Serial I/O • Interrupts, timers, chip-  
selects • 26 pin expansion connector • Built-in Logic Probe • Power  
Supply (can also be battery operated) • Powerful ROM MONITOR to  
help you program • Connects to your PC for programming or data  
logging (cable included) • Assembly, BASIC, and C programming  
(varies with model) • Program disks with Cross Assembler and many,  
well documented, program examples • User's Manuals: cover all details  
(over 500 pages) • Completely assembled and ready to use • Source  
code for all drivers and MONITOR • Optional Text Book

Everything you need. From \$279.  
Money Back Guarantee

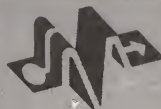
Call for Free Info Pack, or see  
WEB at <http://www.aesmicro.com>  
714-550-8094, FAX 714-550-9941

**AES**  
Advanced Educational Systems

**Call 1-800-730-3232**

AES 575 ANTON BLVD., SUITE 300, COSTA MESA, CA 92626, USA





## BK PRECISION®

The 5300 Series, one of the world's finest digital multimeters. The best of the ASYQ II Series, it has the best accuracy, a built-in counter, and displays AC voltage as resistive power or dB (impedance selectable), saving you the time of making the calculation. A careful examination of the performance features and user-conscious design will tell you that you hold a superior DMM in your hand, designed with measurement capability needed by users who demand the best.

MFG	MODEL	ACCY	LIST	SPECIAL PRICE
B&K	5360/MX53B	0.1%	\$229.00	<b>\$129.00</b>
B&K	5380/MX55	0.025%	\$309.00	<b>\$139.00</b>
B&K	5390/MX56B	0.025%	\$325.00	<b>\$149.00</b>

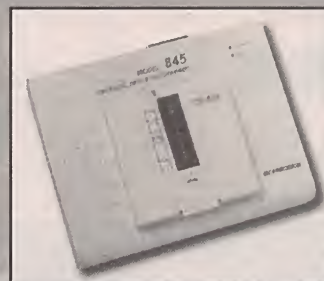
(resistive power on model #5390/MX56B)

• meters made in France by Metrix for B&K, feature 50,000 count capability, bargraph, true RMS, mains disturbance indication, good transient protection, a wide temperature range, conform to IEC 1010 class 2 safety compliance & 3 year warranty

The 845 is a software expandable universal device programming workstation that supports a wide variety of programmable devices with the added capability to test digital ICs. It is the most sophisticated low-cost programmer available today. A unique hardware/software architecture enables the Model 845 to easily grow in support and engineering software design capabilities as quickly as your device library requirement. State-of-the-art universal programmer offers you the most advanced programming facilities with the most user-friendly interface. Since each pin is software addressable, new part numbers can be added to the list of supported devices through software upgrades. The 845 interfaces with IBM, PC, XT, PS/2, AT, 386, 486, Pentium, portable or compatible personal computers. The standard pack-age allows you to directly connect to your PC through any standard parallel printer port (no special interface card or special modules needed).

MODEL	DESCRIPTION	REGULAR	SALE
840	Eeprom Programmer (single socket)	205.00	192.95
841	Eeprom Gang Programmer (4 sockets)	260.00	251.95
842	Universal Programmer	695.00	611.95
843	Universal Programmer (parallel port interface)	795.00	699.95
845	Universal Programmer (parallel port interface) Windows based	1295.00	1139.95
846	Universal Programmer (parallel port interface)	495.00	435.95
847	Universal Programmer (4 sockets, parallel port interface)	595.00	523.95

### Universal Device Programmer & Logic IC Tester Model #845



## KENWOOD

MODEL CS-4125

20 MHz, 2 Channel Oscilloscope, with probes & 3 year warranty  
Suggested Price \$595.00

**SUPER SPECIAL \$389.00 w/free t-shirt!!!**



MODEL	DESCRIPTION	REGULAR	SUPER SALE PRICE
CS-4135	40 MHz, 2 CH, 12 kV CRT w/scale illumination, 3 year warranty	855.00	<b>685.00 w/free Kenwood t-shirt!</b>
CS-5350	50 MHz, 3 CH, Delayed Sweep, w/Readout & Cursors, 3 year warranty	1650.00	<b>1235.00 w/free Kenwood Sweatshirt!</b>
CS-5355	50 MHz, 3 CH, Delayed Sweep, 3 year warranty	1485.00	<b>1115.00 w/free Kenwood Sweatshirt!</b>
CS-5370	100 MHz, 3 CH, Delayed Sweep, w/Readout & Cursors, 3 year warranty	2035.00	<b>1525.00 w/free Kenwood Sweatshirt!</b>
CS-5375	100 MHz, 3 CH, Delayed Sweep, 3 year warranty	1815.00	<b>1360.00 w/free Kenwood Sweatshirt!</b>

## Electronic Training Videos From UCANDO

MODEL	DESCRIPTION	REGULAR	SALE
VT401	AM Radio: Major stages of AM, signal conversion, signal detection, audio reproduction. AM stereo. 61 Minutes	44.95	39.95
VT402	FM Radio Part 1: Bandwidths, RF amplifier, mixer-oscillator, IF amplifier, limiter FM detector. 58 Minutes	44.95	39.95
VT404	TV Part 1, Intro to TV: Gain an overview of the television system and how the stages work together. 56 Minutes	44.95	39.95
VT405	TV Part 2, The Front End: UHF-VHF tuning stages, automatic fine tuning, remote control. 58 Minutes	44.95	39.95
VT406	TV Part 3, Audio: The sound strip, stereo TV, secondary audio programming, professional channels. 57 Minutes	44.95	39.95
VT501	Understanding Fiber Optics: Basic fundamentals, cable design, connectors, couplers, splicing. 58 Minutes	44.95	39.95
VT502	Laser Technology: Laser theory, types of lasers, applications, safety precautions. 57 Minutes	44.95	39.95



### SAVE EVEN MORE!

Buy any six videos for only \$216.00. Order your UCANDO videos today!

**PRINT™**  
Products International

Call, fax or email today for complete specs on any of the above products, and a copy of our 84 page test and measurement instrument catalog

8931 Brookville Rd \* Silver Spring, MD, 20910

800-638-2020 \* Fx 800-545-0058 \* [www.prodintl.com](http://www.prodintl.com) \* [sales@prodintl.com](mailto:sales@prodintl.com)





# Mark V Electronics, Inc.

8019 E Slauson Ave  
Montebello CA 90640

Free Catalog 323/888-8988  
Fax 323/888-6868

## DIY Audio Electronic Kits Enclosures & Transformers more than 60 items available!

ORDER 1-800-521-MARK

http://www.mark5co.com Email: mark5co@aol.com

### 3 1/2" Digital LED Panel Meter #TY-43

It is a precision A/D converter integrated circuit. The display is a 6" LED for high visibility. It is easy to assemble and use the meter as a voltmeter, ammeter, ohmmeter, thermometer, frequency counter or capacitance meter. DC  $\pm 199.9$  mV full scale input 5-6VDC.

Kit: \$28.00 ~~15.00~~

### 20 Color LED Audio Level Meter #TY-13

Use this dual LED display indicating meter with your stereo power amplifier to indicate instantaneous speaker power. Operating range is -30dB to +5dB & can be calibrated to operate with 1-200W amplifiers. Not consume any amplifier power. A peak LED illuminates on overload!

Asmb: \$38.50 ~~9.99~~

### 130-in-one Electronic Lab Kit #KA-902

Build your own AM broadcast station, electronic organ, timer, logic circuits... No special tools or soldering required due to pre-mounted parts, pre-cut wires & simple coil-spring connectors. Requires 6 "AA" batteries.

\$29.99 ~~19.99~~

### 40W Mini Stereo Multi-Input Amp #TA-83

Operated from AC source as well as 12V DC car battery. Used as a microphone PA amplifier while simultaneously mixing with an auxiliary input source such as CD & MD player.

Kit: \$30.50 ~~24.40~~

### 300W MOSFET Power Mono Amp #AF-3

300W RMS into 4 ohms, 200W RMS into 8 ohms. Frequency response: 10Hz-20KHz THD < 0.03%. SN 91 dB. Input Sensitivity & Load impedance at 1KHz, 1V 47K & 4-16 ohm. Power Requirement:  $\pm 55V$  -  $\pm 65V$  DC at 8A (each channel). A speaker protection circuit which provides time delayed speaker turn on.

Kit: \$99.00 ~~165.00~~

### 120W + 120W Pre & Main Stereo Amp

It has provision for input program source switching, a phono pre-amp stage with RIAA equalization, 3-band tone controls, built-in power supply rectifier & filter & a speaker protection circuit. It only needs to be installed in a suitable housing & the addition of a power transformer in order to make it operational. #TA-800MK2

Kit: \$67.92 ~~49.00~~

Asmb: \$86.95

We accept Visa, MasterCard, Discover & Money Orders. Checks allow 2 weeks for clearance. We ship by UPS ground inside US (min \$6.00) and ship by US mail outside US. Please call for orders shipping & handling or fax (foreign) orders. In business since 1985.

### Clearance Sale...

#KA-901 30-in-one Electronic Lab kit \$ 6.99  
#KA-903 Electronic Experiment kit 14.99  
#KA-905 75-in-one Electronic Lab kit 12.99  
#KA-906 300-in-one Electronic Lab kit 44.99

## Metal Cabinets

### Aluminium Front Panel

LG-1273 3x12x6 1/4" \$ 26.50  
LG-1684 4x16x8" 32.50  
LG-1924 4x19x11 1/2" 38.25  
LG-1925 5x19x11 1/2" 42.00  
LG-1983 2 1/2 x 19x8" 35.25  
LG-1923 3x19x11 1/2" 36.50  
LG-1927 7x19x11 1/2" 52.50  
LG- Black anodized rack cabinet

Best Buy

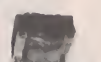
LL-1923B 2 1/2 x 19x12" \$ 69.50  
LL-1925A 5x19x12" 79.50

\*LL-Full Aluminum, Front .157" & other .078"

\*LL-Gold plated cap screw for front panel

### Power Transformer Toroidal Transformers

#001 28/30Vx2 6A \$ 30.00  
#002 36Vx2 3A 25.00  
#003 40Vx2 6A 32.00  
#004 24Vx2 6A 25.00  
#005 26Vx2 3A 20.00  
#006 18Vx2 5A 20.00  
#007 53Vx2 8A 47.00  
#008\* 28/30Vx2 6A 42.00  
#010 30/36Vx2 400mA 8.50  
#011\* 9Vx2 22A 62.00  
#012\* 33/42Vx2 6A 52.00



Transformer



\*Toroidal Transformer

### 60W + 60W Stereo Power Amp

#SM-302



Kit \$85.00 ~~69.00~~

Asmb \$99.00

It provides 3 input jack pairs. One pair will accept a high impedance microphone. The 2 remaining pairs are for high level & low level input sources. These input jacks are selected by a panel mounted slide switch. This unit will operate effectively with all preamps. 60W per channel into 4 ohm RMS, 33W RMS per channel into 8 ohm. 20 to 20KHz. THD < 0.1%. Mic/Guitar 10mV 300 ohm-47K ohm.

CIRCLE 325 ON FREE INFORMATION CARD

## Start an exciting career as a Telecommunications Technician

Train at home in your spare time for an exciting new career! Earn as much as \$35,000 a year and more working with fiber optics, radar and cellular networks.



This ICS program is endorsed by the National Association of Radio and Telecommunications Engineers (NARTE) and features a voucher for the NARTE Class IV Technician Certification exam.

Mail Coupon below for **FREE** facts or call toll free

1-800-595-5505 ext. 3106

Call Anytime — 24 hours a day, 7 days a week.  
http://www.icslearn.com AG01

**YES!** Please send me free information on how I can train at home for a career as a Telecommunications Technician. There's no obligation.

Name \_\_\_\_\_ Age \_\_\_\_\_  
Street \_\_\_\_\_ Apt. # \_\_\_\_\_  
City/State \_\_\_\_\_ Zip \_\_\_\_\_  
Phone ( ) \_\_\_\_\_



**International  
Correspondence Schools**

A Subsidiary of Harcourt Brace & Company  
Dept. ADE059S, 925 Oak Street, Scranton, PA 18515

## BEST DEALER PRICING!

# CABLE DIRECT

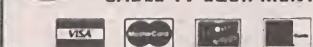
CONVERTERS • FILTERS  
DESCRAMBLERS

IMPROVE YOUR IMAGE WITH  
VIDEO STABILIZERS

FREE  
CABLE TV  
CATALOG!

100%  
MONEY BACK  
GUARANTEE!

Now you can tune-in your favorite  
cable TV programming  
and **SAVE \$100'S** -  
**EVEN \$1000'S** on premium  
CABLE TV EQUIPMENT.



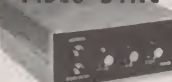
## MODERN ELECTRONICS

1-800-906-6664

2609 S. 156TH CIRCLE • OMAHA, NE 68130

http://www.modernelectronics.com

## VIDEO SYNC GENERATOR



Restores Horizontal  
and Vertical  
Sync Lines from  
Distorted Video



Lost Sync



Restored Sync  
with VSG

For Free Information Package and Pricing

Call (219) 233-3053  
www.south-bend.net/rcd

R.C. Distributing, P.O. Box 552, South Bend, IN 46624

## PicC C Compiler \$59

for Microchip's PIC microcontrollers  
Supports PIC16C55x, 16C6x, 16C62x, 16C8x, 16C92x PIC families

## SnXC C Compiler \$59

Supports ScentIX ex18ac and ex28ac microcontrollers  
Both compilers based on ANSI C standard. Arrays, unions, structures, pointers, strings, function calls, if, for, switch, while, interrupt vectors, in-line assembler code, 8 & 16 bit variables, etc. Outputs Intel Hex format and assembly code. Code optimizer included. Excellent development tools!

## DebugIDE Debugger \$79

C source level debugger for PicC and SnXC compilers. Integrated Development Environment. Step, Run, Stop, Reset. Variable monitoring and modification. Oscilloscope/cable kit (\$39)  
732-873-1519 fax: 732-873-1582 e: grichrc@aol.com  
Grich RC Inc. 120 Cedar Grove Ln, Ste 340, Somerset NJ USA 08873  
URL: http://members.aol.com/picccompile

## FCC License Preparation

Electronics Tech., Avionics, Marine & Radar  
HOMESTUDY—Fast, Easy & Inexpensive  
Manuals, Audio, Video, PC disks, latest Q&As  
Free 1-800-800-7555 "Guaranteed Pass"  
See at http://www.worldaccessnet.com  
BusinessShowcase/wpt. 4701 NE 47th St.  
Vancouver, WA 98661 — WPT Publications



# PROFESSIONAL DESOLDERING with the World's Best Transportable, Totally Self-Contained Desoldering Tool

**Now Get**

## More Vacuum

**Mike Murphy - Service Center - Van Nuys CA 818-785-7805**

The single best investment of repair equipment we've made. It outperforms all other desoldering tools we've used. Easier to use and least expensive.

**Dick Manning - Dicks Electronics - Hartland WI 414-367-8339**

The ease & speed of component removal greatly increases productive time. The SMD kit makes SMD removal a breeze, even for inexperienced Techs.

## Quicker Vacuum

**Don Scott -**

**LAV Electronics - Healeah-Miami Lakes FL**

I am a constant user of the SC7000 Desoldering Tool and for quick component removal, this unit has no equal. It also comes with excellent company support. I am very satisfied and highly recommend it to anyone in the servicing field.

**George Hefner - Hefner Electronics - Coleridge NE 402-283-4333**

Being a one-man service center, I hesitated to spend the money on a desoldering tool, however all that changed when I nearly ruined a \$400 computer logic board. It has cut my desoldering time by 50%.

## Higher Temperature

**Don**

**Cressin - Certified Electronics Service - Ellicott City MD 301-461-8008**

We have obtained excellent results with the SC7000 including repairing high density U/V tuners. It is one of the best purchases we have made.

**Doug Pettit - LuRay Electronics - LuRay VA 703-743-5400**

We found that the SC7000 not only saves money vs. wick, but saves valuable time in troubleshooting. It allows you to be more accurate in removing SMD's.

**Sale Price  
\$395.00**

## New Features

- ◆ Totally Self Contained diaphragm vacuum pump and AC motor for high vacuum suction or reversible hot air blow for SMD removal.
- ◆ 100 Watt Ceramic heater with zero-crossover switching heater control circuit which prevents spikes and leakage currents.
- ◆ Unique patented long lasting filter cartridge design. Solder builds up on easily cleaned baffle, while air flows around the outside of baffle.
- ◆ Totally ESD Safe. The housing contains carbon and the tip is at ground potential for complete ESD Protection.

**Howard Electronic Instruments, Inc.  
6222 N. Oliver Kechi, KS 67067**



**FREE TRIAL**  
Available on Request

Price includes  
stand worth \$25.00  
one extra filter, and  
two tip cleaners.

**Timothy Kraft - Monikraft, Inc.  
Cherry Hill NJ 609-751-3252**

We replaced all our existing desoldering stations with the SC7000. Our technicians are very pleased with the improved performance, portability, and reliability over our previous higher priced equipment.

**Bill Warren CET/CSM -  
Warrens Audio & Video -  
Knoxville TN - 234-546-1128**

We have been extremely satisfied with the quality and durability of the DEN-ON SC7000 as well as with after the sale support.

**Keith Sahs - J & M Electronics  
Omaha NE 402-291-7100**

It's a must tool for my bench. I can desolder multiple pin IC's quickly and clean. It will even take up large solder amounts on tuner and case grounds.

**For More Info  
and 5% Savings Go To**

**<http://www.heinc.com/sc7000zb.html>**

## New Specifications

- ◆ Voltage———AC 100v, 120V, 230V, 50/60 HZ
- ◆ Power Consumption———120W
- ◆ Pump———Diaphragm Type
- ◆ Motor Output———12W
- ◆ Vacuum Attained———650mm Hg
- ◆ Temperature Range———300° C—500° C (572° F—932° F)
- ◆ Air Flow Rate———15 Liter/Minute (Open)
- ◆ Heater———100W (Ceramic)
- ◆ Control System———Feed Back Zero Cross-over Type
- ◆ Net Weight———420 Grams

**Visa - M/C - Discover - American Express - Terms to Qualifying Companys  
30 Day Money Back Total Satisfaction Guarantee - One Year Parts and Labor Warranty**

**HOWARD  
ELECTRONIC  
INSTRUMENTS INC**  
*Your Desoldering Specialists*

**Toll Free U.S. and Canada  
1-800-394-1984**

**Web Site [www.heinc.com](http://www.heinc.com)  
E-Mail [sales@heinc.com](mailto:sales@heinc.com)  
International (316) 744-1993  
or Fax (316) 744-1994**

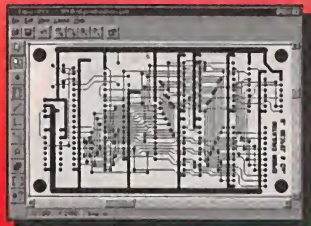
CIRCLE 331 ON FREE INFORMATION CARD



# PCB LAYOUT

Software For Windows - FREE

- 1 Download our board layout software
- 2 Design your 2 sided plated-through PCB
- 3 Send us your layout over the Internet
- 4 In 2-3 business days, UPS delivers your boards, often under \$100



[www.expresspcb.com](http://www.expresspcb.com)

## 32K 68HC11 - PLUG 'N PLAY!



Adapt11C24DX is a compact (2.8" x 2.1") 68HC11 module that 'plugs right in' to virtually any solderless breadboard. Build your own application circuit in minutes! Adapt11C24DX has all essential 68HC11 support circuitry, including 32K EEPROM for your code, lots of digital & analog input/output lines, RS232 interface and a 5-Volt regulator. Program it in C, BASIC, or assembler. Easy in-circuit re-programming via your PC's serial port makes it a valuable re-usable educational & hobby tool. Starter Package #AD11C24DX-SP.....only \$139 includes serial cable, demo program, utility software & handbook. Other configs available, from \$74.95. See website, or call.

### TECHNOLOGICAL ARTS

Phone: (416) 963-8996 • Fax: (416) 963-9179  
www.technological-arts.com

## 1 MB cache, AMD 350

3DNow System featuring:  
Enlight Mini Tower, VIA chipset, 100 MHz operation, 2 USB ports, 64 MB PC-100 compatible memory, 7.5 GB 7200 rpm Ultra DMA33 hard drive, 40X CD-Rom with audio button, 4 MB SGRAM AGP video card, S3 Trio 3D, 1.44 floppy, V.90/X2 PCI faxmodem, 3D sound card, full-size speaker set, 15" digital monitor, Windows 98 on CD.....\$899

### tech-specialities, Inc.

(800)864-5391, fax: (713)307-0314

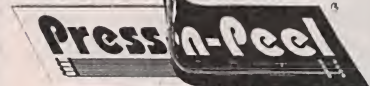
email: sales@ts.nu, web: www.ts.nu

Detailed Quote on other configurations (PII 300/450, single/dual CPU or low cost, IBM 300 MHz, 32 MB - \$699 w. monitor) by email, fax or phone. Ask for our Free Shipping option! Illustrated 32-page Catalog with latest parts, many more system options, benchmark comparisons and technical tips free!

## Printed Circuits in Minutes Direct From LaserPrint!

8 1/2" x 11"  
• Or Photocopy  
\*\*Use standard household iron or P-n-P Press.

1. LaserPrint\*
2. Press On\*\*
3. Peel Off
4. Etch



Use Standard Copper Clad Board  
20 Shts \$30/ 40 Shts \$50/ 100 Shts \$100  
Visa/MC/PO/Ck/MO \$4 S&H

Techniks Inc.

P.O. Box 463

Ringoes NJ 08551

ph. 908.788.8249 fax 908.788.8837

<http://chelsea.ios.com/~techniks>

Retail Dealer Inquires Invited

## PIC PROJECTS Book & CD-ROM

Many PIC Projects for Beginners & Experts!  
Includes Software, Documentation, and PCB Layout

Book & CD Only \$24.95

- LCDs
- X10 — Home Automation
- Keypads
- Serial Port Interface
- On-Screen Displays
- Robotics
- Data Logging
- Serial-Parallel
- And Many More!

### PIC Programmer

Programs all PIC16C55x/6x/7x/8x/9x, PIC 16F8x, and PIC12C devices. Optional ZIF adapters for SOIC & PLCC. Includes all necessary software. Only \$39.95

Buy Both for \$59.95

We accept

VISA • MasterCard • American Express

To order, call Worldwyde @ 1-800-773-6698  
21385 Randall Street • Farmington Hills, MI 48336  
Visit us on the web at [www.worldwyde.com/pic](http://www.worldwyde.com/pic)

## 10 Hr. Telephone Recorder \$69.95



Automatically starts recording when the phone is picked up and stops when you hang up. Records both sides of the conversation! Telephone recording controller only \$15  
3 Hour Micro Telephone recorder with tape \$49

FREE CATALOG  
[www.mscelectronics.com](http://www.mscelectronics.com)

### MSC Electronics

PO BOX 461 Jessup, MD 20794

(301) 497-1600

FAX (301) 497-1925



## FRIENDLY LITTLE MICRO CONTROLLER

\$149 (single)



...packs a **MEAN** punch  
a.k.a. "Steroid Stamp"

- 39 I/O + 8 A/D (10 bit) •
- 128K SRAM + 128K Flash •
- LCD/Keypad Interface •
- Fast 16 bit Motorola CPU •
- Affordable C Compiler •
- Comprehensive s/w Library •

\* Intec Automation Inc. v: 250-721-5150  
[www.steroidmicros.com](http://www.steroidmicros.com) fx: 250-721-4191

## PIC Programmer Kits

Our PIC Programmer Kits of parts attach to the parallel port of a PC and contain the following: PCB, parts and instructions. Uses a straight through (25 pin) cable (not supplied). S&H: USA \$4.95, Canada \$7.95 Other \$11.95

### P16PRO PIC Programmer

• Program all 8, 18, 28 & 40 pin PICs in the 12C5xx, 14000 and 16Cxx series (except 16C54-58). • This kit uses the P16PRO software which is downloaded from the web and registered for \$20. • Visit [www.electronics123.com](http://www.electronics123.com) for the complete list of PICs that can be programmed. • Can program 64 pin PICs with adapter (not supplied). • New PICs can be added.

**PICALL PIC Programmer:** As above but can also program 16C54-58. Price includes PICALL software. (need internet for latest upgrade) Price \$79.95 Order Code: CPS117

**PIC 16C/F84 Programmer:** Software supplied on disk is for 16F84 • 16F84-4MHz PIC included! • EEPROM • Separate erase command • Test command to check programmer & cable • Vpp (programming voltage) is under software control • Microchip data sheets on disk •

\$28.95

Code: CPS81

For the beginner!

Toll Free 1-888-549-3749 (USA & Canada)  
Tel (330) 549-3726. Request a FREE catalog or visit us at [www.electronics123.com](http://www.electronics123.com) for more products.  
Amazon Electronics, Box 21 Columbiana OH 44408

## ELECTRONIC COMPONENTS

J-Tron, an electronic components distributor serving manufacturers and hobbyists.

- Capacitors
- Resistors
- Test Meters
- Kits
- NTE Devices

Web [www.j-tron.com](http://www.j-tron.com)

Visit our website & enter our contest for a test meter.

**CALL TODAY!**  
**888-595-8766**

**24 Hour Fax:**  
**973-478-8708**



## The Hack & Crack Bible on CD-ROM

Includes all Software, Documentation,  
Plans, and PCB Layouts!

Unlock the secrets of:

• DSS & Smart Cards  
– Programming & Schematics

• Cable Test Devices

• Sony Playstation  
– Mod Chip/CD Backups/Emulation

• Backup Sega & SNES Console Cartridges

• Sega & SNES Emulation on your PC or Mac

• WareZ – where to find them on the Internet

• Cellular Hack/Phreak/Mod

• And Much More!

PC & Mac Compatible CD-ROM

We accept

VISA • MasterCard • American Express

To order, call Worldwyde @ 1-800-773-6698

21365 Randall Street • Farmington Hills, MI 48336

Visit us on the web at [www.worldwyde.com/hack](http://www.worldwyde.com/hack)

Only  
\$29<sup>95</sup>

## LASER MODULE



Auto Power Control  
Collimated Laser  
Compact Size  
100,000 hr lifetime  
No Electronics Required

Visible Laser Modules (635-670 nm)  
TTL Modulated Laser Modules  
Line Generator Laser Modules  
Infrared Laser Modules (780-830 nm)

from  
\$29 (US)

## LASER POINTER



Focus Adjustable  
Elegant Design  
Solid Metal Body

Pen Style Laser Pointer (1500 ft visibility)  
Key Chain Laser Pointer (1500 ft visibility)  
Available in silver and, black finish.

\$19.95 (US)

World Star Tech.

Ask for free catalog

Tel: (416) 204 6298 Fax: (416) 506 7619

<http://www.worldstartech.com> e-mail: [info@worldstartech.com](mailto:info@worldstartech.com)

## An Introduction to Light in Electronics

### An Introduction to Light in Electronics

F.A. WELSH



Taken for granted by us all perhaps, yet this book could not be read without it, light plays such an impressive role in daily life that we may be tempted to consider just how much we understand it. This book makes a good start into this fascinating and enlightening subject. It has been written with the general electronics enthusiast in mind.

To order Book #BP359 send \$6.99 plus \$3.00 for shipping in the U.S. and Canada only to Electronics Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240. Payment in U.S. funds by U.S. bank check or International Money Order. Please allow 6-8 weeks for delivery.

ET08

[www.jm-micro.com](http://www.jm-micro.com)

## PIC In-Circuit Emulator

for the PIC16Cxx from \$295

PIC Programmer \$155

80C552 (8051) Development

Training System \$235

68HC11 SBC \$120

ROMY-16 EPROM Emulator  
from \$195

Universal Microprocessor  
Simulator/Debugger (including  
Assembler, and Disassembler)  
\$100 each CPU

## J&M Microtek, Inc.

83 Seaman Rd, W Orange, NJ 07052

Tel: (973) 325-1892 Fax: (973) 736-4567

## Serial Video Text Display Module

NEW BOB-II superimposes up to 308  
characters on NTSC/PAL video or gen-  
erates video. 30-pin SIMM design, fast  
RS-232 serial interface, easy to use for:

Video Inspection - NDT  
Home Automation - MATV  
Surveillance - CCTV - ATV  
Remotely Piloted Vehicles  
Gaming - Racing - Sports  
Process/Experiment Monitor  
Robotics - Electronic Signs

Very Low Cost ~ Really!

Complete Information at: [www.decadenet.com](http://www.decadenet.com)

DECADE ENGINEERING



5504 ValView Dr. SE, Turner, OR 97392

Tel: 503.743.3194 ~ Fax: 503.743.2095

## Cable T.V. Converters & Equipment

Lower  
Prices  
Dealer  
Discounts  
30-Day  
Money back  
1-year  
warranty  
MC, Visa,  
AE, COD



No Florida Sales

[www.cable4you.com](http://www.cable4you.com)

1-(800) 888-5585

## Low Cost PICmicro Tools



EPIC Pocket PIC Programmer - \$59.95

♦ Programs PIC12C50x, 67x, 16C55x, 6x, 7x, 8x

PICProto Boards - \$8.95 to \$17.95

PicBasic Compiler - \$99.95

new! PicBasic Pro Compiler - \$249.95

BASIC makes it easy for you to program the  
fast and powerful Microchip PIC microcontrollers.

♦ Expanded BS1/2 compatible instruction set  
♦ True compiler provides faster program execution  
and longer programs than BASIC interpreters

microEngineering Labs, Inc.

Box 7532 Colorado Springs CO 80933

(719) 520-5323 fax: (719) 520-1867

<http://www.melabs.com>

## 3 Axis Motion Control System Complete, ready to run

\$295.00 + 12.00 S/H

Build or adapt CNC mills, CNC routers, Robots, Etc.  
Includes: 3 Stepping motors (70 oz/in 200 steps/rev).  
External board (connects to parallel port of a PC). Power  
supply. Cables, Manual and the MAXNC drive software,  
with linear, circular and helical interpolation, acceleration  
deceleration, full contouring, 'G' code programming,  
screen plot, code generation from CAD (CAM), and more.

For more information,

phone or write to:

MAXNC

6730 West Chicago

Suites 2 & 3

Chandler, AZ 85226

Ph (602) 940-9414

Fax (602) 940-2384



## CONTROL YOUR WORLD

32K HC11  
**ModCon**

Low Cost Microcontroller boards & kits + Applications

**ZORIN** <http://www.Zorinco.com>  
or call (206) 282-6061

## SINGERS! REMOVE VOICALS

Unlimited, Low Cost, Instantly Available  
Background Music from Original Standard  
Recordings! Does Everything Karaoke  
does... Better and gives you the  
Thompson Vocal Eliminator!  
Free Brochure & Demo Tape.  
LT Sound Dept. EN  
7988 LT Parkway, Lithonia, GA 30058  
Internet: <http://www.LTSound.com>  
24 Hour Demo/Info Request Line (770) 482-2485 • Ext 72  
When You Want Something Better Than Karaoke!



# CABLE TV EQUIPMENT

Converters, Test Cubes & Chips  
Video Stabilizers



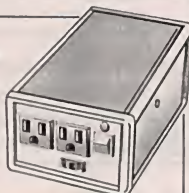
1 Year Warranty  
30 Day Money  
Back  
Guarantee

**"ABSOLUTE LOWEST  
WHOLESALE &  
RETAIL PRICES"  
CABLE U.S.A.  
1-888-388-CUBE**

NEW INVENTION!  
BUILD YOUR OWN

## 5,000 WATT INVERTER

Input 12 vdc  
Output 120 volts AC 60 HZ



You can build this simple but POWERFUL inverter with parts you may already have laying around the house! There is no other inverter built like this inverter. Now anyone can afford a 5,000 watt inverter. Run your entire home!

PATENT PENDING

1000 watt plans.....\$25.95  
5000 watt plans.....\$40.00

FREE CATALOG

Send order to: CREATIVE SCIENCE  
PO BOX 557 New Albany, IN. 47151

## SURVEILLANCE

The Latest High Tech  
Professional Electronic Devices

Our latest catalog offers a HUGE selection of surveillance, counter-surveillance/privacy devices: pinhole camera \$129<sup>00</sup>, hidden video, "realtime" 12-Hour telephone recorder \$139<sup>00</sup>, 12 hour VOX recorder phone call register, scanners, bug/phone tap detectors, voice disguisers, locksmithing tools, vehicle tracking, wireless video, and much more. Wholesale/retail.

We will not be undersold.

Catalog \$5.00 or  
www.spyoutlet.com

**SPY OUTLET**

PO Box 337, Buffalo NY 14226  
(716) 691-3476/(716) 695-8660

ABC ELECTRONICS 315 7TH AVE N. MPLS. MN. 55401  
(612)332-2378 FAX (612)332-8481 E-MAILSURP1@VISI.COM  
WE BUY TEST EQUIPMENT AND COMPONENTS.  
VISIT US ON THE WEB AT WWW.ABCTEST.COM

HP 54501A 100MHZ DIGITIZING SCOPE	\$1300.00	HP 4935A TRANSIMPAIRMENT TEST SET	\$900.00
HP 54201D 300MHZ DIGITIZING SCOPE	\$1000.00	HP 5006A SIGNATURE ANALYZER	\$150.00
HP 54201A 300MHZ DIGITIZING SCOPE	\$1000.00	HP 86602B 1MHZ-1300MHZ RF PLUG	\$400.00
HP 54200A 50MHZ SCOPE/WAVEFORM ANALYZER	\$700.00	EIP 575 MICROWAVE COUNTER	\$1500.00
HP 3312A 13MHZ FUNCTION GENERATOR	\$250.00	FLUKE 95 50MHZ SCOPEMETER	\$550.00
HP 3370A 100MHZ U.T.I. COUNTER	\$400.00	LECROY 7200 400MHZ O-SCOPE	\$1000.00
HP 3580C LEVEL METER	\$750.00	TEK 475 200MHZ O-SCOPE	\$500.00
HP 436A POWER METER W/O SENSOR&CABLE	\$500.00	TEK 465 100MHZ O-SCOPE	\$400.00
HP 8350B SWEEP OSCILLATOR MAINFRAME	\$2000.00	TEK 496P 1KHZ-1.8GHZ SPEC ANALYZER	\$3500.00
HP 3437A 3.5DIGIT SYSTEM VOLT METER	\$250.00	TEK 1240 LOGIC ANALYZER	\$750.00
HP 3455A DIGITAL MULTIMETER	\$250.00	TEK TDS320 100MHZ DIGITAL O-SCOPE	\$1400.00
HP 3456A DIGITAL MULTIMETER	\$400.00	TEK 11401A 500MHZ PROG O-SCOPE FRAME	\$750.00
HP 3336C SYNTHESIZER/LEVEL GENERATOR	\$800.00	TEK 7854 400MHZ OSCILLOSCOPE FRAME	\$500.00
HP 3325A SYNTHESIZER/FUNCTION GENERATOR	\$1000.00	TEK 7904 400MHZ OSCILLOSCOPE FRAME	\$250.00
HP 5335A 200MHZ COUNTER	\$600.00	TEK 7A26 200MHZ VERTICAL PLUG	\$75.00
HP 8165A PROGRAMMABLE SIGNAL SOURCE	\$1100.00	TEK 7A24 400MHZ VERTICAL PLUG	\$150.00
HP 8558B/181 100K-1500MHZ SPECTRUM ANALYZER	\$1000.00	TEK 7B80 400MHZ TIME BASE	\$75.00
HP 8559B/183 10MHZ-21GHZ SPECTRUM ANALYZER	\$3000.00	TEK 7B92A 500MHZ DUAL TIME BASE	\$125.00
HP 1740A 100MHZ OSCILLOSCOPE	\$250.00	TEK 7512 SAMPLING PLUG	\$250.00
HP 6034A 60VDC-10A POWER SUPPLY	\$750.00	TEK 7L14 10KHZ-1.8GHZ SPEC. ANALYZER	\$1000.00
HP 6209B 40VDC-50A POWER SUPPLY	\$800.00	TEK AM503 CURRENT PROBE AMPLIFIER	\$250.00
HP 6553A 40VDC-12.5A POWER SUPPLY OPT.J01	\$1200.00	WAVETEK 145 20MHZ PULSE/FUNCTION GEN.	\$400.00
HP 6632A 20VDC-5A POWER SUPPLY	\$500.00	WAVETEK 182A 4MHZ FUNCTION GEN.	\$150.00
HP 6643A 45VDC-4.3A POWER SUPPLY OPT.J03	\$750.00	WAVETEK 955 7.5-12.4GHZ MICROSOURCE	\$1100.00

## CAD FILES TO CASH PILES

IMAGINE THE POSSIBILITIES!

NOW YOU CAN

TURN YOUR

DREAMS

INTO

REALITY!



STARTING AT  
\$895.00

3 AXIS UNITS FROM  
12" X 12" TO 60" X 60"  
MACHINING AREAS

THE

## ROBOPRO X50

CNC ROBOTIC MACHINING SYSTEM

YOUR WISH IS ITS COMMAND!

ROUTE, MILL, DRILL, CARVE,  
ENGRAVE, PAINT, ETC. . . .  
IN WOOD, PLASTIC, VINYL,  
PC BOARD, & LIGHT METALS

FREE 3D



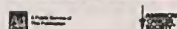
CAD/CAM

U.S. CYBERLAB, INC., 14786 SLATE GAP ROAD  
WEST FORK, AR 72774 (501) 839-8293

Visit us at [www.uscyberlab.com](http://www.uscyberlab.com)

BREAST CANCER BEGINS  
EVEN SMALLER THAN THIS.  
THAT'S WHY YOU  
NEED A YEARLY  
MAMMOGRAM.  
ESPECIALLY AS  
YOU GET OLDER.  
MAMMOGRAMS  
CAN DETECT  
LUMPS TOO  
SMALL FOR  
YOU TO FEEL  
AND EARLY  
DETECTION  
MAY SAVE  
YOUR LIFE,  
SO CALL  
1-800-  
ACS  
2345.

GET A MAMMOGRAM.  
EARLY DETECTION IS THE BEST PROTECTION.



## PC BOARDS

Low Cost, Precision-Made PC Boards  
From Your Gerber/NC Drill Files

Put your CAD  
program to  
work for you!



• Milling  
• Drilling  
• Routing

[www.pcbmilling.com](http://www.pcbmilling.com)

FAX: (703) 818-0071

## !!!BROADCAST EQUIPMENT!!!


We manufacture & carry Stereo FM Transmitters,  
RF Amplifiers, Low Pass Filters, Antennas, DJ Mixing  
Boards & Consoles, Mics, Compressor/Limiters, Digital  
Reverbs, Automation Software, RF Test Equipment, RF Parts  
Including BGY133's, and much more! Call For Free Catalog.

Progressive Concepts  
BOX 596 STREAMWOOD, IL 60107  
(630) 736-8622 FAX: (630) 736-0393






### AM Transmitter



- Sub Miniature module
- SAW Controlled
- No adjustable components
- Low current - 2.5mA
- Supply 2.5-12Vdc

• 418MHz or 433MHz  
• Range up to 300ft  
• CMOS/TTL data input  
• 7 x 11 x 4mm !  
**AM-TX1-xxx .... \$12.60**


### AM Receiver



- Compact Hybrid Module
- Very stable
- CMOS/TTL output
- Patented Laser Trimmed
- 5Vdc, 0.8mA (HRR6)

• 2kHz data rate  
• Sensitivity -105dBm  
• 38 x 12 x 2 mm  
**AM-HRR6-xxx... \$16.33**


### FM Transceiver



- Only 23 x 33 x 11mm
- Up to 40,000bps data rate
- Up to 450ft. range.
- 5V operation
- 418MHz or 433MHz FM

• 5V CMOS logic interface  
• Fast 1ms enable  
• Power saving feature  
• Carrier Detect output  
**BiM-xxx-F ..... \$87.36**


### RS232 Transceiver



- 3wire RS232 interface
- 19.2Kbps half duplex
- 418MHz or 433MHz FM
- 7.5-15Vdc, 20mA
- TX/RX Status LED's

• Up to 400ft. range  
• 1/4 wave ant. on board  
• User data packetizing  
• 58 x 40 x 15mm  
**CYPHERNET .... \$139.30**

### AM Transmitter



- Range up to 250ft.
- SAW controlled stability
- Wide supply range 2-14V
- CMOS/TTL input

• Low current. 4mA typ.  
• Up to 4KHz data rate  
• Small: 17 x 11mm  
**AM-RT5-xxx .... \$12.10**



**THINGS THAT WORK  
TESTED BY HOME POWER**

**Measures  
Watts  
& Watt-hours  
(kW-hr)**

Simple to use.  
Plug the Power Meter  
into any AC outlet, and plug the  
appliance to be measured into the  
Power Meter. That's it!

**Model 4-1850:**

- Measure REAL ("true") power  
1 to 1850 Watts
- Measure Power used, 1 Watt-hour  
to 9999 kilo-Watt-hr
- Measure power cost (\$), just enter  
cost per kilo-Watt-hr

**New! RS-232 Interface**  
features data logging, on-  
screen measurement, display  
and analysis. Can be added  
to either model, only \$50!

**Model 20-1850** does everything the 4-1850 with these additional  
features: Irms, Vrms, Power Factor, 20 mhz processor and more!

**Model 4-1850 Only \$149.<sup>95</sup> Delivered!**  
**Model 20-1850 Only \$249.<sup>95</sup> MC/Visa/MO/Check**

**Custom applications available • Dealer inquiries welcome**

**Brand Electronics,**  
421 Hilton Rd.  
Whitefield, ME 04353  
For information only, call 1-207-549-3401  
email: ebrand@mint.net

**Call today! To order, call toll free, 24 Hrs.**  
**1-888-433-6600**  
<http://www.mint.net/~ebrand/>

**WITH  
SPECTRUM  
ANALYZER,  
DVM, FREQ.  
COUNTER,  
AND DATA  
LOGGER.**

from

**\$189.**

**PORTABLE  
MODULES  
CONVERT PC'S  
INTO  
MULTIPURPOSE  
TEST AND  
MEASURING  
INSTRUMENTS.**

**O-Scope Ie**

250 mV/div  
100 mSec/div  
0 Trig Lev. % PS  
Trigger Slope +  
100 Hold Time (ms)  
0 Vert. Pos.  
AC Sweep 21

Waveform: A series of sharp, periodic pulses.

**O-Scope Ie**

250 mV/div  
100 mSec/div  
0 Trig Lev. % PS  
Trigger Slope +  
30 Hold Time (ms)  
0 Vert. Pos.  
AC Sweep 11

Waveform: A single, sharp pulse.

Why lug a scope around? Toss one of our modules into your laptop case or tool kit. For a multi-purpose test device, plug to a PC parallel port and use the PC screen. Continuous, delayed, or triggered sweeps can be frozen on the screen, printed out, or saved to disk. Frequency Spectrums DC to 25 MHz.

Allison now provides PICO TECHNOLOGY Ltd. portable test equipment, including high-speed scopes, and multi channel data loggers. Pico and O-Scope modules accept standard probes and work with 286 or faster PC's.

## FEATURES:

- ◆ PORTABLE UNITS TO 25 MHz
- ◆ USES PRINTER PORT
- ◆ USES STD. PROBES

**OPTIONS:**

- ◆ PROBE SETS
- ◆ AUTOMOTIVE PROBES
- ◆ BATTERY PACKS
- ◆ SOFT & HARD CASES

**O-Scopes Made in U.S.A.**

**Picos Made in U.K.**

**Same Day Shipping**

**Includes Cable, Software & Manuals**

O-Scope I p (DC-50KHz, single trace) .....\$189.

O-Scope I (DC-500KHz, single trace) .....	\$199.
O-Scope II (DC-500KHz, dual trace) .....	\$349.

PICO (ADC 200/20) (DC-10MHz, dual trace) ..... CALL

PICO (ADC 200/50) (DC-25MHz, dual trace) .....CALL

PICO pc based data loggers from \$99.

Shipping within U.S. UPS Ground \$7.50/Second day \$11.50

Shipping within U.S. UPS Ground \$7.50(Second day \$11.50)

**SEND CREDIT CARD INFO., M.O., or CHECK, OR CALL**

SEND CREDIT CARD INFO., M.O., OF CHECK, OR CALL  
1-800-800-8006

**1-800-980-9806**

1 000 700 7000

## Allison Technology Corporation

**Johnson Technology Corporation**

2006 FINNEY-VALLET, ROSENBERG, TX 77471  
PHONE 281 338 8533 FAX 281 338 8888

**PHONE: 281-239-8500 FAX: 281-239-8006**

<http://www.atcweb.com>

<http://www.dlcweb.com>

---





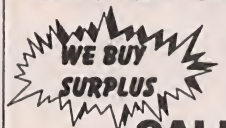
# Test Equipment Sales



## CHECK OUT THESE SPRING SPECIALS !

TEK 2236 100 MHz SCOPE W/ BUILT-IN  
FREQUENCY COUNTER.....\$895  
TEK 2246 100 MHz 4 CH. SCOPE W/  
"Smartcursors"& ON-SCREEN R.O....\$1195  
B&K 2630 1 GHz SPEC. ANALYZER (NEW)  
w/ TRACKING GENERATOR.....\$3095  
HP 4277A LCZ METER.....\$3295  
ESI 296 AUTO DIGITAL LCR METER.....\$1195  
HP 8656B SIGNAL GENERATOR.....\$2595  
HP 8350B SWEEPER MAINFRAME.....\$2195  
GR 1863 MEGOHMMETER.....\$595  
AR 4040AT 3KV AC HYPOT TESTER.....\$575

FLUKE 5440B DCV CALIBRATOR.....\$1495  
FLUKE 8502A BECHTOP DMM.....\$495  
HP 1141A DIFFERENTIAL PROBE.....\$895  
HP 1142A PROBE POWER MODULE...\$275  
HP 1651A 32 CH. LOGIC ANALYZER.\$1195  
HP 8642B SIGNAL GENERATOR.....\$14,900  
HP 3585A SPECTRUM ANALYZER.....\$5995  
HP 3325A SYNTH./FUNCTION GEN....\$1295  
HP 3577A NETWORK ANALYZER.....\$8950  
HP 3488A SWITCH CONTROL UNIT...\$495  
HP 5342A FREQUENCY COUNTER....\$1650  
TEK 1241 LOGIC ANALYZER.....\$450



Ask about our line of new products including  
HP, LeCroy, Instek, Tektronix, Fluke and more !



CALL (800) 684-4651 OR FAX (603) 425-2945

CHECK US OUT AT [WWW.TESALES.COM](http://WWW.TESALES.COM)

CIRCLE 217 ON FREE INFORMATION CARD

### CABLE TV BOXES



(WE'LL BEAT ANY PRICE!)  
30 DAY TRIAL\* 1YR. WRNTY. \*FREE CATALOG  
QTY. DISCOUNTS \* DEALERS WELCOME!

1-800-538-2225

HABLAMOS ESPANOL



<http://www.tvcableboxes.com>  
GLOBAL ELECTRONICS INC.

### SURVEILLANCE HIDDEN CAMERAS

DIRECT FROM MANUFACTURER-BEST PRICE IN THE MARKET

Ultra miniature hidden camera, in dome, smoke or motion  
detector w/ mic. B/W or Color. Wide view angle. Low light  
sensitivity + super sharp images, plus video and audio out-  
put. From \$150.00. Also 1/2" B/W board camera w/mic,  
starts at \$79.00 USD. Wireless hidden camera, start at only  
\$249.00 USD. Plus \$5.95 for S/H. Wholesale Welcome.  
COD, Check, Money Order or Visa/MC.

BOLIDE INTERNATIONAL CORPORATION

PH: (800) 355-0895 or (626) 575-8178

9660 Flair Drive #218, El Monte, CA 91731

<http://www.bolidecameras.com>

### BEST BY MAIL

Rates: Write National, Box 5, Sarasota, FL 34230

"ANARCHIST COOKBOOK" AVAILABLE AGAIN! Complete  
Uncensored Edition. \$25. delivered. Barricade Books,  
Box 1401-K, Secaucus, NJ 07096.

### PERSONAL-MISCELLANEOUS

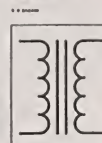
ENDLESS PAIN! Health problems. Wealth needed. Nobody  
cares. Please put Arthur in your will. Arthur F. Bothwell, P.O.  
Box 31, Wildwood, NJ 08260. Jesus loves you.

### WEIGHT LOSS

HOW TO LOSE weight and eat what you want! FREE bon-  
us, call now 24 hour recording message 1-877-266-1990.

ALL NATURAL DIET! For a 3 day sample send \$3.00 to:  
PO Box 681, Shannon, GA 30172, ph. 888-574-6612.

### Coil Design and Construction Manual



### YOU CAN WIND YOUR OWN COILS?

There's no trick to it except  
knowing what you are do-  
ing. In a unique, 106-page  
book you can become ex-  
pert in winding RF, IF,  
audio and power coils, chokes and trans-  
formers. Practically every type of coil is dis-  
cussed and necessary calculations are given  
with the mathematical data simplified for  
use by anyone. Get your copy today!

Mail coupon to:

Electronics Technology Today, Inc.  
P.O. Box 240

Massapequa Park, NY 11762-0240

Please send me my copy of *Coil Design and  
Construction Manual* (BP160). I enclose a check or  
money order for \$8.99 to cover the book's cost  
and shipping-and-handling expenses. NY state  
residents must add local sales tax.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

All orders must be paid in U.S. funds only. Sorry,  
no orders accepted outside of USA and Canada.  
Please allow 6-8 weeks for delivery. ET07

### BUGGED??

EAVESDROPPING is unbelievably widespread! Electronic  
Devices with amazing capabilities can be monitoring your  
telephone and room conversations RIGHT NOW! Are you  
sure you're safe? FREE CATALOG tells you fast! Includes  
Free Bonus details on fantastic opportunities now open in  
Counter-Surveillance field. Exciting, immensely interesting  
and EXTREMELY profitable (up to \$250 hr) full/part-time  
Income. Call Now! 1-800-732-5000

### MAY THE SOURCE BE WITH YOU

Tap into THE SOURCE of useful  
government publications--the free  
CONSUMER INFORMATION CATALOG.

Call toll-free 1-888-8 PUEBLO

### CABLE EQUIPMENT

LOW, LOW WHOLESALE PRICES!

1-800-521-0512

New 1-piece Jerrold-5 units \$109/ea; 10 u. \$99/ea; 20 u. \$89/ea.

New RFT-M -5 units \$109/ea; 10 u. \$99/ea; 20 u. \$89/ea.

Basic Converter -5 units \$75/ea; 10 u. \$65/ea; 20 u. \$55/ea.

WHOLESALE ELECTRONICS

Check out our website: [www.whe.net](http://www.whe.net)



# ALL ELECTRONICS

C O R P O R A T I O N

QUALITY  
PARTS

FAST  
SHIPPING

DISCOUNT  
PRICING

CALL, WRITE, FAX  
or E-MAIL For A  
**Free 96 Page**  
CATALOG.  
Outside the U.S.A.  
send \$3.00 postage.

## Koss Digital STEREO HEADSET

Koss MAC-5  
Made for  
the Ford  
Motor  
Company  
for use in  
Windstar and  
Aerostar Vans. These



lightweight, adjustable  
headsets have great sound quality with great  
bass response for home or studio use. Supra-  
Aural foam ear cushions for hear-through  
sound and comfort. The 8' rubberized cords  
are terminated. Frequency response: 20-  
20,000 HZ. 1/4" stereo phone plug.

**\$12<sup>50</sup>**  
each

CAT # HP-7

## 3000 MCD ULTRA-BRIGHT RED LED

Everlight # 383URC-2/TR1-C(R)  
Red, "Ultra-bright" T 1 3/4 LEDs  
now at our lowest price ever.  
Due to a special purchase of  
"tape-and-reel" parts we are  
able to offer these LEDs at an  
incredibly low price when pur-  
chased on the reel. These  
are 5 mm diameter water-clear LEDs that  
light bright red at 20 ma.



CAT# LED-50

**2 for \$1<sup>00</sup>**

100 for \$35.00  
1000 for \$250.00  
(25¢ each)

## S-VHS Tape (Used)



Super VHS tape users!  
Save a bundle on  
name-brand S-VHS,  
T-120 tapes. These  
tapes were used for a  
brief period, then bulk  
erased. The record-  
protect tabs have been broken  
out, so you will have to cover the  
notch with a piece of tape, but they work  
great and cost a fraction  
of the "new" price.

CAT #S-VHS

**\$3<sup>00</sup>**  
each

10 for \$28.00 • 100 for \$250.00

## 30 Minute Timer Board

Timer circuit board will  
operate 120 or 240 Vac  
devices. Originally  
designed to run a  
vibrating motor in a  
massage chair, the circuit  
automatically shuts-off a  
motor, lamp or other device after approximately  
30 minutes. Shut-off time can be varied by  
replacing one of the resistors on the board  
with a pot or resistor of different value. Hook-up  
instructions included with the board explain  
how to make this modification. 1.9" x 2.5".



CAT# TMR-5

**\$3<sup>50</sup>**  
each

## 10 CD Storage Book

Small padded, refillable  
binder contains plastic  
sleeves for protection and  
storage of 10 CDs. Great  
for music or computer  
software. Inside cover  
has an index page for  
referencing contents.  
Velcro flap keeps binder closed in  
transit. Ideal for car or home. 6.5" x 5.8" x 1.2".



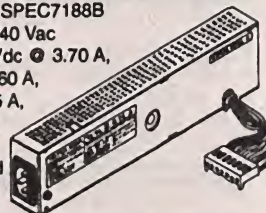
CAT# CDB-1425

**\$4<sup>25</sup>**  
each

10 for \$37.50 100 for \$300.00

## INCREDIBLY CHEAP!! Switching Power Supply

Voltek Corp # SPEC7188B  
Input: 100 - 240 Vac  
Outputs: + 5 Vdc @ 3.70 A,  
+12 Vdc @ 0.60 A,  
-5 Vdc @ 0.05 A,  
+5 Vdc Trickle  
@ 0.1 A  
Metal encased  
switching sup-  
ply. Standard  
three-prong IEC socket power input. 7 conduc-  
tor, Molex-type connector output. 9" x 2.1" x  
1.36". UL recognized. Removed from new  
equipment.

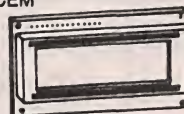


CAT # PS-27

**\$3<sup>50</sup>**  
each

## 20 Character X 4 Line LCD

Optrex # DMC 20434-CEM  
(PWB 20434-CEM)  
5 x 8 dot format.  
3" x 1" viewing area.  
3.88" x 2.38" module.  
Removed from new  
equipment. May have felt padding on metal  
bezel. 14 pin single row header is pre-attached.  
Spec/hook-up sheet included.

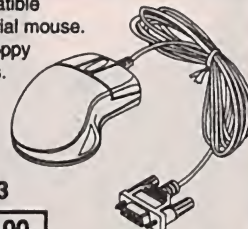


CAT# LCD-46  
10 for \$60.00

**\$7<sup>00</sup>**  
each

## 3 BUTTON Serial MOUSE

Windows compatible  
three button serial mouse.  
Includes 3.5" floppy  
disk with drivers.



**\$3<sup>50</sup>**  
each

CAT #MSE-3

10 for \$30.00

## 100 Meg IDE Hard Drive

Assorted Brands  
100 to 120 MB IDE  
hard drive.  
Removed  
from working  
equipment.  
5.77" x  
4.02" x 1".



Used

CAT #HD-100U

10 for \$80.00

**\$9<sup>50</sup>**  
each

## "HI-8" Video Cassette

SONY Hi-8 Top quality,  
metal particle 120 minute  
video cassettes. Used  
for a short time, then  
bulk-erased. Each  
cassette has its own  
plastic storage box.



CAT # VCU-8

**\$3<sup>00</sup>**  
each

10 for \$28.00 • 100 for \$250.00

ORDER TOLL FREE

**1-800-826-5432**

MAIL ORDERS TO:  
ALL ELECTRONICS CORP.  
P.O. BOX 567  
VAN NUYS, CA 91408-0567

FAX (818) 781-2653 • INFO (818) 904-0524  
INTERNET <http://www.allcorp.com/>  
E-MAIL [allcorp@allcorp.com](mailto:allcorp@allcorp.com)

NO MINIMUM ORDER • All Orders Can Be Charged to Visa, Mastercard, American Express or Discover • Checks and Money Orders Accepted by Mail •  
Orders Delivered in the State of California must include California State Sales Tax • NO C.O.D. • Shipping and Handling \$5.00 for the 48 Continental United  
States • ALL OTHERS including Alaska, Hawaii, P.R. and Canada Must Pay Full Shipping • Quantities Limited • Prices Subject to change without notice.

**MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write, E-MAIL or Fax YOUR LIST.**



## Locate Bad Caps Fast

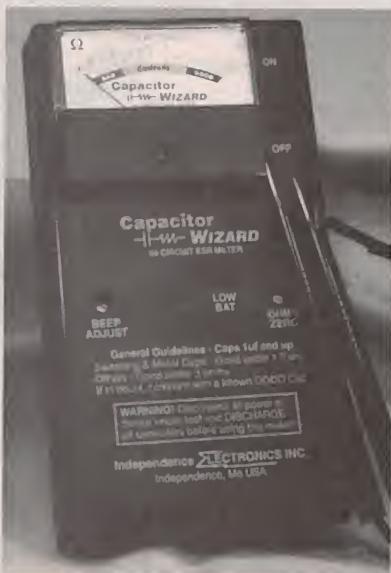
### IN-CIRCUIT!!

Lower Costly Service Time  
Reduce Costly Callbacks  
Tame "TOUGH DOGS" in Minutes  
**INSIST on the ORIGINAL**

**Capacitor™**  
**WIZARD**

IN-CIRCUIT ESR METER

Large, easy to read analog meter makes for the fastest, most accurate testing available! Unique "Cap GOOD" beeper makes testing caps in circuit **virtually INSTANTANEOUS!!** Needle sharp **GOLD PLATED** stainless steel probes provide **FAST** and **POSITIVE** connection to both **AXIAL** and **RADIAL** caps.



Technicians say the Capacitor Wizard is "the most cost effective instrument on their workbench!"

**ONLY \$179.95**

**800-394-1984**

For More Information goto  
[www.heinc.com/ieinc/cwinfo.htm](http://www.heinc.com/ieinc/cwinfo.htm)

**30 DAY MONEY BACK GUARANTEE**  
**Order today! You Can't Lose!!!**

**Made in the USA!**



**Howard Electronic Instruments, Inc.**  
6222 N. Oliver, Kechi, KS 67067  
316-744-1993 International  
316-744-1994 Fax  
Email: [sales@heinc.com](mailto:sales@heinc.com)



## AUDIO-VIDEO-LASERS

Unique Video Products Pattern Generators with character identification, composite, s-video, RGB, distribution amplifiers, kits also available. FREE catalog, **GEKCO Labs**, PO Box 642, Issaquah, WA 98027-0642, 425-888-5756, [www.gekco.com](http://www.gekco.com)

## BUSINESS OPPORTUNITIES

Have an idea? If so, we are a national company working with ideas, inventions, new products. Patent services. Call 1-800-288-IDEA.

**\$400 Weekly Assembling** electronic circuit boards/products from home. For Free information send SASE: Home Assembly-EN Box 216, New Britain, CT 06050-0216.

## CABLE TV

Cable TV descramblers. One-piece units. Scientific Atlanta, Jerrold, Pioneer, and others. Lowest prices around. **Prodelon Electronics**, Houston, TX anytime 1-800-691-4810.

**CABLE DESCRAMBLING, New secret manual.** Build your own descramblers for cable and subscription TV. Instructions, schematics for SSAVI, Gated Sync, Sinewave, \$12.95, \$2 postage **CABLETRONICS**, Box 30502E, Bethesda, MD 20824.

**New!** Jerrold and Pioneer wireless test units \$125 each, also 75DB notch filters \$19.95 each, quantity pricing available please call **KEN ERNY ELECTRONICS** 24-hour order and information hot line 516-389-3536.

**Cable boxes all models, all channels, lowest prices in the United States.** Open seven days a week till midnight, Pacific Time. Call (877) 789-7337 Toll-Free.

**Free Cable Descramblers Plans.** For Details Write: Sierra Publishing, 909 E. Yorba Linda Blvd., Suite H-181, Dept. ENB, Placentia, CA 92870.

**Pay TV & Satellite descrambling 1999 Edition.** All the latest cable and satellite fixes \$16.95. Complete Pay TV series (282 pages) \$59.95. Hacking satellite systems video \$29.95. Scrambling News subscription with web access \$34.95. Everything listed above \$99.95. Free catalog. **Scrambling News**, 4798 South Florida Ave., Lakeland, FL 33813. 941-646-2564. C.O.D.'s are O.K. Add \$6.00.

**CABLE TV DESCRAMBLERS. ALL MAJOR BRANDS. RFTs. HAVE MAKE AND MODEL NUMBER OF CONVERTER USED IN YOUR AREA WHEN CALLING. QUANTITY DISCOUNTS. K.D. VIDEO 1-800-327-3407.**

**CABLE DESCRAMBLERS**, including activators for all Jerrold Dp5-CFT 22xx's and SP's. Lowest single or lot prices. Also, **RFT-Dams Zenith**, **SCIENTIFIC ATLANTA**, and **PIONEER**. Se habla en español. Call 888-684-9277.

**ALL CABLE TV BOXES. WE'LL BEAT ANY PRICE. 30 DAY TRIAL 1 YEAR WARRANTY. 1-800-538-CABLE(2225).**

**Descramblers, Converters, Activators, Rft's, Flg's, Bullet Snipers, All Options Explained, Best Prices, Services, 2yr. Warranty, Free Catalog 1-800-854-1674 [www.resource-leader.com/aapc](http://www.resource-leader.com/aapc)**

**NEW!** Cellphone E.S.N. readers \$250 each, cell phone programmers \$175 each, cell phones \$25 each, DSS satellite dish card readers and programmers \$125 each, credit card readers \$250 each, Cable TV. notch filters 50 cents each, converter boxes \$50 each, magnetic strip card readers for ATM machines, bank cards, drivers license, and all types of data acquisitions all under \$200 each. You pay these super low prices when you deal directly with the manufacturers. When you order "Direct Connection" a 150 page directory published by Ed Treki Publications, you will receive the largest collection of names, addresses, and phone numbers of all the leading American and International manufacturers of these products never before available. Stop paying second, third and fourth hand prices and deal directly with the source!!! Order your copy of "Direct Connection" today for only \$59.95 plus \$5 shipping. All orders are sent C.O.D. Please call Ed Treki Publications 24 hour order hot line 914-544-2829.

**CABLE TV DESCRAMBLERS-GUARANTEED LOWEST PRICES! STARTING AT \$99.00. ALL MAJOR BRANDS. NOBODY BEATS OUR PRICES EVER! AAA CABLE 1-888-929-8669.**

## CB-SCANNERS

**CB Radio Modifications!** Frequencies, kits, high-performance accessories, books, plans, repairs, amps, 10-Meter conversions. The best price since 1976! Catalog \$3.00. **CBCL** Box 1898 EN, Monterey, CA 93942. [www.cbclintl.com](http://www.cbclintl.com)

**CB Trick Books**, three books 1, 2 and 3. Each book \$19.95 each. Repairs, tune ups, and amplifiers. Send money order to **Medicine Man CB** PO Box 37, Clarksville, AR 72830.

## COMPUTER HARDWARE

**ROBOT Module.** Abundant outputs, inputs, counters, compass, analog. Infinite configuration \$299.00. Free catalog **WINDesign**, Box 138, Boston, NY14025.

## EDUCATION

**Learn Electronics.** Home Study. Outstanding Careers. Free Literature. **P.C.D.I.**, Atlanta, Georgia. Call 800-362-7070. Dept. ELG342.

## PLANS-KITS-SCHEMATICS

**Awesome Kits:** Voice Changers, Levitators, Lasers, Solar Robots and more! Catalog \$1.00. **LNS Technologies**, PO Box 67243, Scotts Valley, CA 95067 [www.ncal.verio.com/~Lnstech](http://www.ncal.verio.com/~Lnstech)

**ELECTRONICS PROJECT KITS:** \$3.00 catalog. 49 McMichael St. Kingston, ON., K7M 1M8. [www.qklits.com](http://www.qklits.com) - **QUALITY KITS**

## SATELLITE EQUIPMENT

**DSS Hacking:** How to construct and program smart cards, w/pic 16C84, software. Complete DSS system schematics, \$16.95. **CABLETRONICS** Box 30502E Bethesda, MD 20824.

**Free catalog-satellite TV/GPS-DIY Technical Books, Installation Videos, Computer Analysis Software** [www.baylin.com](http://www.baylin.com) 800-483-2423.

**DSS Test card.** Authorizes all channels for information, plus free bonus. Call toll free 1-888-416-7296.

**FREE Satellite TV Buyer's Guide.** Best Products - Lowest Prices - Fastest Service! Dish Network, DirectTV, C/Ku-band, including 4DTV. Parts - Upgrades - Accessories! **SKYVISION** - 800-543-3025. International 218-739-5231 [www.skyvision.com](http://www.skyvision.com)

## TEST EQUIPMENT

**Large assortment of used test equipment for sale.** Request catalog or visit our website. **Stevenson Equipment Company** 609-888-2846 Fax: 609-888-2847 <http://www.stevensonlabs.com>

**Test Equipment Sale!** Complete listing at <http://www.astglobal.com> or call **NOW** to receive list by fax or mail. **AST GLOBAL ELECTRONICS:** Voice 888-216-7159, Fax 814-398-1776; e-mail: [sales@astglobal.com](mailto:sales@astglobal.com)

## WANTED

**WANTED: USED TEST EQUIPMENT. TURN IDLE OR EXCESS EQUIPMENT INTO CASH.** **AST GLOBAL ELECTRONICS:** Voice 888-216-7159; Fax 814-398-1176; e-mail: [sales@astglobal.com](mailto:sales@astglobal.com)

## FOR SALE

**HAVING A BEEPING OR CHIRPING SOUND WITH SCRAMBLED VIDEO ON CHANNELS. WE CAN HELP. PROFESSIONAL QUALITY POSITIVE NOTCH FILTERS. \$16.00EA. DISCOUNTS ON 5 OR MORE. 100 @ 7.00. FAST COURTEOUS SERVICE. ALL CREDIT CARDS. CALL THE FILTER COMPANY, 1-800-684-0527 OR [www.gofilters.com](http://www.gofilters.com)**



# RETAILERS THAT SELL OUR MAGAZINE EVERY MONTH

## Arizona

Circuit Specialists, Inc.  
220 S. Country Club Dr.  
Bldg 2  
Mesa, AZ 85210

## California

California Electronics  
221 N. Johnson Ave.  
El Cajon, CA 90202

Ford Electronics  
8431 Commonwealth Ave  
Buena Park, CA 90621

All Electronics  
14928 Oxnard Street  
Van Nuys, CA 91411

Mac's Electronics  
191 South "E" Street  
San Bernardino, CA 92401

Electronics Warehouse  
2691 Main Street  
Riverside, CA 92501

Orvac Electronics  
1645 E Orangethorpe Ave.  
Fullerton, CA 92631

Sav-On Electronics  
13225 Harbor Blvd.  
Garden Grove, CA 92643

JK Electronics  
6395 Westminster Blvd.  
Westminster, CA 92683

Kandarian Electronics  
1101 19th Street  
Bakersfield, CA 93301

Minute Man Electronics  
37111 Post St., Suite 1  
Fremont, CA 94536

HCS Electronics  
6819 S. Redwood Drive  
Cotati, CA 94931

Halted Specialties Co.  
3500 Ryder Street  
Santa Clara, CA 95051

Metro Electronics  
1831 J Street  
Sacramento, CA 95814

HSC Electronics  
4837 Amber Lane  
Sacramento, CA 95841

## Colorado

Centennial Electronics  
2324 E. Bijou  
Colorado Sps., CO 80909

## Connecticut

Cables & Connectors  
2198 Berlin Turnpike  
Newington, CT 06111

Electronic Service Prod.  
437 Washington Avenue  
North Haven, CT 06473

## Georgia

Normans Electronics Inc.  
3653 Clairmont Road  
Chamblee, GA 30341

## Illinois

Tri State Elex  
200 W. Northwest Hwy.  
Mt. Prospect, IL 60056

## Indiana

Black Cat  
566 S. Main Street  
North Webster, IN 46555

## Maryland

Mark Elec. Supply Inc.  
5015 Herzel Place  
Beltsville, MD 20705

## Massachusetts

U-Do-It Electronics  
40 Franklin Street  
Needham, MA 02194

## Michigan

Purchase Radio Supply  
327 East Hoover Avenue  
Ann Arbor, MI 48104

Norwest Electronics  
33760 Plymouth Rd.  
Livonia, MI 48150

The Elec. Connection  
37387 Ford Road  
Westland, MI 48185

## Minnesota

Acme Electronics  
224 Washington Avenue N.  
Minneapolis, MN 55401

## New Jersey

Lashen Electronics Inc.  
21 Broadway  
Denville, NJ 07834

## New York

LNL Distributing Corp.  
235 Robbins Lane  
Syosset, NY 11791

Unicorn Electronics  
Valley Plaza  
Johnson City, NY 13790

## Ohio

Philcap Electronic Suppliers  
275 E. Market Street  
Akron, OH 44308

## Oregon

Norvac Electronics  
7940 SW Nimbus Avenue  
Beaverton, OR 97005

## Texas

Tanner Electronics  
1301 W Beltline  
Carrollton, TX 75006

Mouser Electronics  
958 N. Main Street  
Mansfield, TX 76063

Electronic Parts Outlet  
3753 B Fondren  
Houston, TX 77063

Computers Electronics Etc.  
110 E. Medical Center Blvd.  
Webster, TX 77598

**If you'd like to sell our magazine in your store,  
please circle 210 on free information card  
or  
Contact Christina Estrada at (516) 293-3000 ext 223**



# Measure the Sun's Intensity with a Solar Dosimeter

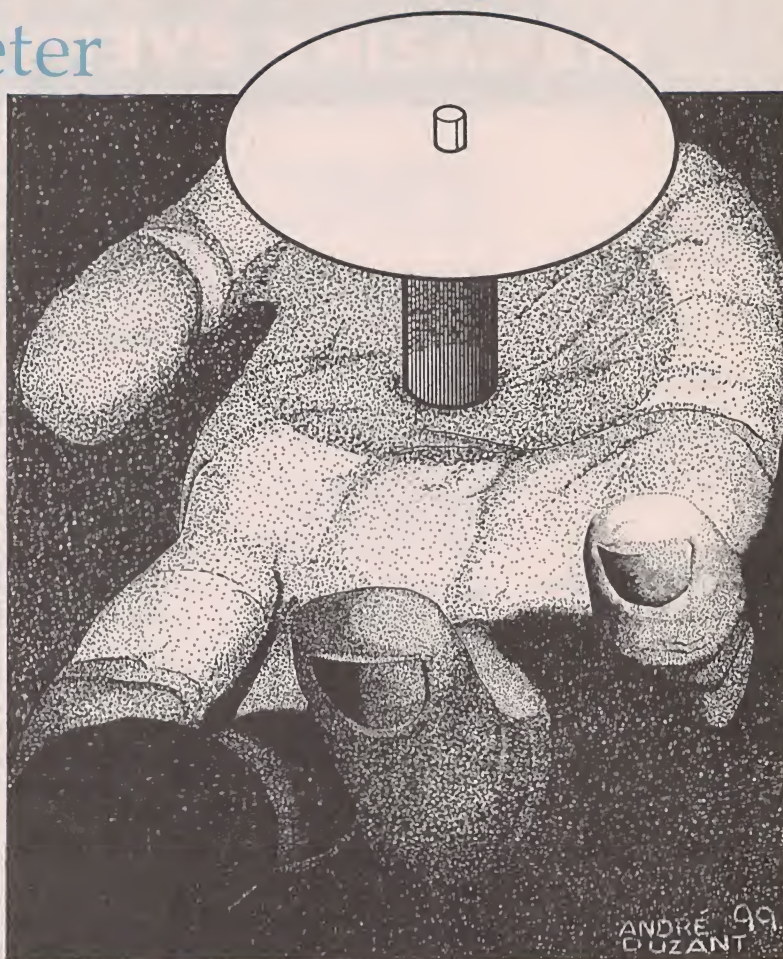
*You can achieve suprisingly accurate results with this simplest of circuits.*

PAUL NEHER

There are many times where you would want to know how much sunlight a particular location receives—though some of them are not so obvious. Many of us are aware of the health risks that are associated with ultraviolet radiation; recent studies have linked cancer and premature aging of the skin to ultraviolet radiation exposure. Even older people can be at risk of developing cataracts and should be wearing ultraviolet-absorbing sunglasses whenever they are outdoors. If you are looking into setting up photovoltaic or solar-heating panels, the choice of whether to install a tracking mechanism, with its increased cost, depends on the site location and how many hours of direct sunlight the panels will receive. Vegetable and flower gardens are another area of concern—do they receive too little or too much sunlight?

Whether planning a solar installation, measuring how much sunshine a potential garden spot gets, or just curious about how many hours per day you are exposed to the sun, an instrument that can measure the total number of hours of sunlight per day would be a handy tool to have. Of course, such "solar-site analyzers" exist and can be purchased for a couple of hundred dollars, but there is a less-expensive alternative.

In this article, we'll take a look at how solar-radiation monitors, or dosimeters, have worked in the past, and how to build a modern version that, while not exactly the



most accurate instrument in the world, can't be beat for cost. In fact, you probably have the components needed in your "junk drawer". If, on the other hand, you purchase all of the items needed, you would be hard-pressed to spend much over a dollar.

**Sunshine Recorders.** Meteorological instruments designed to record the duration of sunshine have been used since the mid-nineteenth Century. One particularly clever recorder is the Campbell-Stokes device, dating from about 1880. It uses a glass sphere to focus sunlight onto a strip of paper. Like a magnifying glass, the strip of paper is held

at the lens' focal point. The intense heat from the focused spot of light burns the paper. As the sun moves across the sky, a black trace is left on the paper showing how long the sun was unobstructed. It can record the sun's movement from horizon to horizon if it is properly aligned, and it can reveal fixed obstructions, such as buildings and trees, as well as variable amounts of cloud cover if several days worth of readings are taken and compared. Although there is a certain aesthetic quality to a recording instrument that is self-powered, that style of recorder lacks portability.

**Electronic Dosimeters.** While many different types of electronic dosimeter circuits are available, most of them are based on active components to record the collected data; the elegant simplicity of a self-powered device is not taken into account.

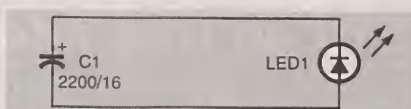


Fig. 1. Don't be fooled by the simplicity of the solar dosimeter's circuit—it is suprisingly accurate for such a low-cost device.



Consider the electrical characteristics of a light-emitting diode. In its usual method of connection, an LED has a constant voltage drop across it, producing light when about 10 mA of current flows through it. When the voltage is reversed, the LED doesn't produce light and the current flowing through it is very small—on the order of nanoamps. On the manufacturer's data sheets, that current is referred to as *leakage current*. However, that is not entirely correct when it comes to LEDs.

Although an LED is designed as a light-producing device, it is also a small-area photovoltaic diode that is capable of passing a current when it is exposed to light. Under normal room lighting, the conductivity of an LED is only in the nanoamp range, but in bright sunlight the photocurrent is about one microamp.

Most low-cost LEDs that are used as panel indicators are only tested for forward operation. The reverse-breakdown voltage is typically specified at five volts. That doesn't mean that the device can't withstand higher reverse voltages; it's just the maximum voltage that the manufacturer tests the LED for. All of the LEDs that the author has tested have shown actual reverse-breakdown voltages of at least 50 volts; most units are greater than 100 volts.

In the region of the LED's reverse-voltage characteristic between the breakdown voltage and zero volts, the device acts like a constant-current element, with the current depending only on the intensity of the light.

Now that we have a light-dependent constant-current source, we need some way to record the overall amount of current that passes through the LED.

A capacitor stores an electric charge in proportion to the voltage across its terminals. The formula for that relationship is

$$Q=CV$$

where the total charge ( $Q$ ), in coulombs, is a product of the capacitance ( $C$ ), in farads and the voltage ( $V$ ), in volts. A constant current flowing into (or out of) a capacitor will change the voltage

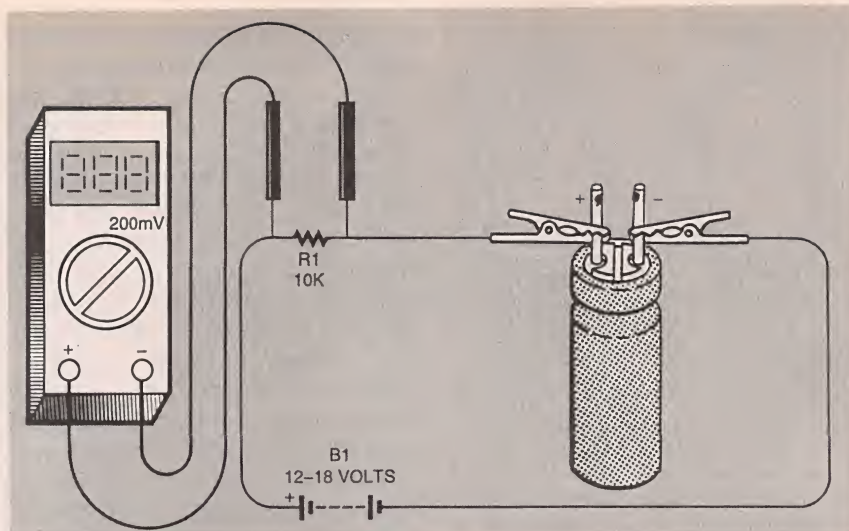


Fig. 2. Measuring the voltage drop across a resistor in series between the capacitor and a battery is an easy way to measure the capacitor's leakage current.

across its terminals at a rate that is proportional to the current. For example; a 1- $\mu$ F capacitor being charged with a constant one-microamp current will increase its voltage by one volt per second.

The capacitor's voltage is also proportional to the amount of current that has been accumulated over a period of time; that function is a near-perfect integrator. The same one microamp current in the above example, applied for 100 seconds, will change the voltage on the capacitor by 100 volts.

Based on that knowledge, let's put an LED in parallel with a capacitor. There are few electronic circuits that can match the simplicity of Fig. 1, but that's all that it takes to build a simple, self-powered solar dosimeter that can be used to

measure the amount of sunlight that falls on a given area over a period of time.

If you charge up C1 in a dark room, very little current will flow through LED1; C1 will stay charged up for a long time. Place the unit in bright sunlight and a larger constant current will flow through LED1, discharging C1 at a rate that is proportional to the intensity of the light. For example, if C1 discharges at a rate of 1.25 volts per hour in bright sunlight, the voltage should change by 5 volts if it is exposed to the same intensity of light for 4 hours.

Typically, you would charge up C1 to about 15 volts; that voltage and the values shown will let the solar dosimeter be used for over a day before needing a recharge. In bright sunlight, such as the southwestern

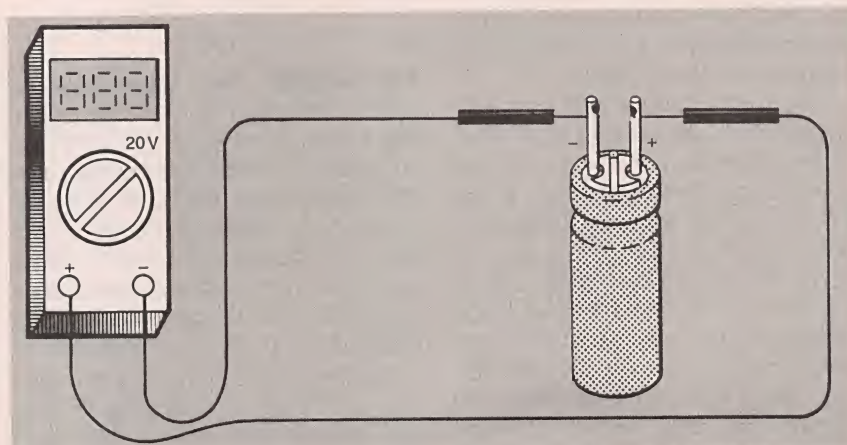


Fig. 3. When measuring how much voltage the capacitor has lost, make your measurement as quickly as possible—even the most sophisticated digital voltmeter consumes some of the capacitor's charge when taking a reading.



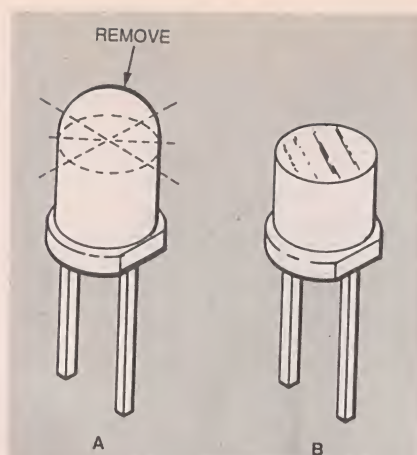


Fig. 4. A standard LED has a lens molded into its case to concentrate the light. By flattening the lens, the solar dosimeter will be able to sense sunlight from almost any angle.

US, the capacitor discharges at a rate of about one volt per hour.

Another advantage of the solar dosimeter is that it directly simulates the performance of a solar panel or photovoltaic array—the change in capacitor voltage is directly proportional to the amount of ampere-hours that the array would produce for that day. If you would like to investigate whether a tracking array would be worth the extra money, simply compare the results from first leaving the solar dosimeter pointed in one direction, and from pointing it at the sun by changing its position about once every hour. Many locations, such as southern California, have morning fog and hazy skies until mid-morning. Mountains and other obstructions can reduce the amount of direct sun that your location receives. With a little data collection and analysis, the solar dosimeter can help you find the best orientation for a solar array.

Of course, a circuit that is this simple is not a perfect one. There are several restrictions that must be followed to get the most out of it. The first is to understand that the solar dosimeter has a probable error of about 10% due to the nonlinearity of the LED current and the leakage characteristics of the capacitor. Unfortunately, electrolytic capacitors have an internal leakage mechanism that allows a small amount of current to flow between its “insulated” plates. You can think of that leakage as a resistor across

the capacitor’s terminals. That leakage increases with temperature.

You should always charge the unit from a 12- to 18-volt source in series with a 10,000-ohm resistor. The resistor prevents the components from being destroyed if you connect the battery backward by accident; it also protects you if the source happens to be a car battery and you accidentally connect the charging leads together. However, the charging voltage should never be higher than the capacitor’s working voltage. If you are going to be using an 18-volt source, such as two 9-volt batteries in series, you should use a capacitor that is rated higher than the 16-volt rating that is specified here—25 or 35 volts would be better.

That being said, let’s see what we need to do to build our solar dosimeter.

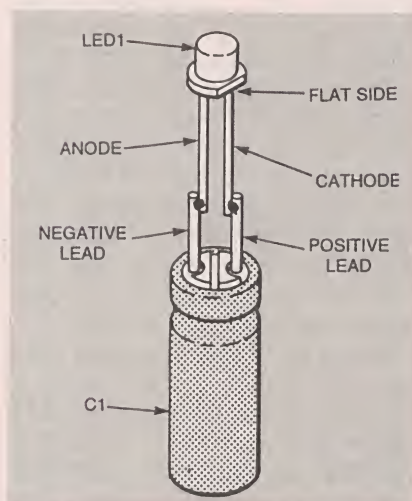


Fig. 5. To build the solar dosimeter, simply solder an LED onto a capacitor. Be careful of polarities or the unit won’t work.

**“Seasoning” the Capacitor.** To reduce leakage, a new capacitor has to be “seasoned” for a day or so before it can be used in the solar dosimeter. Interestingly, a capacitor pulled out of a junk car radio or old piece of audio equipment would be perfect for our needs because it has had many hours of voltage applied to it. A new electrolytic capacitor must have its dielectric layers formed by applying a voltage for several hours. An ideal place to do that is inside a warm parked car using the 12-volt lighter jack as the voltage source.

Alternatively, you can charge the capacitor from a pair of nine-volt batteries and leave it connected for a day inside your home, perhaps on a sunny windowsill.

Once a capacitor is “aged”, its internal leakage needs to be tested; there is always the possibility that a particular unit might not be suitable. After charging the capacitor for several minutes, connect a digital voltmeter across the resistor. Do not use an older style “moving-needle” meter. Those instruments draw a bit of current from the circuit being measured and will introduce errors in your readings. The voltage drop across the resistor will show the capacitor’s leakage current; a reading of 10 mV indicates a leakage of 1 microamp. At first the leakage might be quite large, perhaps a few microamps. After several hours, the meter should read zero mV, indicating an internal leakage of less than  $1/10$  microamp. That is a good indication that the capacitor is forming well. The general arrangement for that test is shown in Fig. 2.

Next, disconnect the capacitor from the charging source and voltmeter, and let it sit for an hour in its charged condition. Measure its voltage by connecting the meter only long enough to get a reading as shown in Fig. 3, and again at least 12 hours later. If the capacitor is a “good one”, it will have lost only a few tenths of a volt between readings. A capacitor that loses more than about one volt will be marginal for use in the solar dosimeter because of the error it introduces.

**Construction.** The first step in building the solar dosimeter is to modify

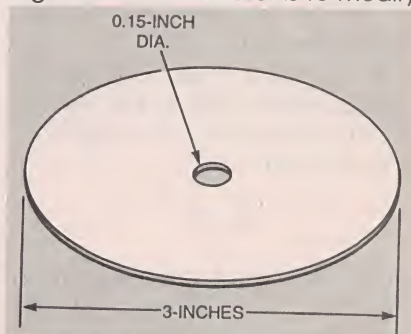


Fig. 6. To increase accuracy of the solar dosimeter, the capacitor must be kept cool. This disc, cut from an index card, will act as an umbrella, shielding the capacitor from the sun.



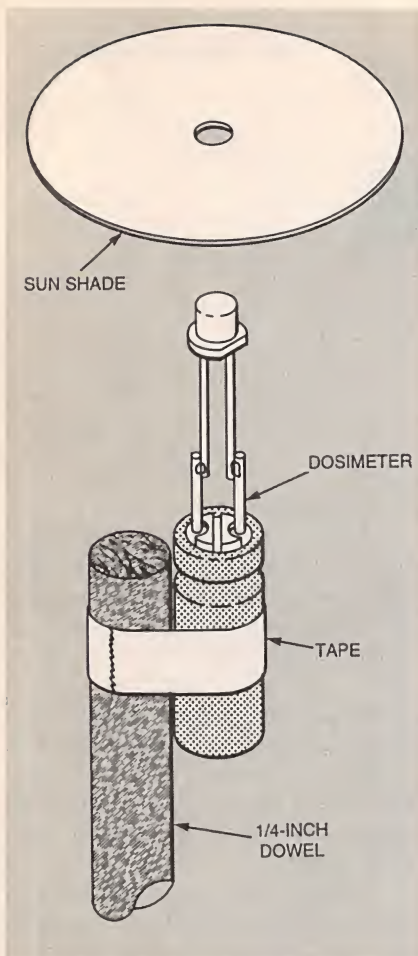


Fig. 7. With the solar dosimeter mounted on a dowel and wearing its "hat", it's ready to measure the amount of sunlight anywhere that you want it to.

the LED by filing or sanding off its top. Most LEDs have a rounded lens as shown in Fig. 4A. By removing the lens, you will have an angular sensitivity of almost 180 degrees. The LED should look like Fig. 4B.

The two components are soldered together as shown in Fig. 5. Obviously, there is a right way and a wrong way to connect the two polarized components together. The positive lead of C1 should be connected to the cathode of LED1; the cathode lead of LEDs is usually physically longer in length and a flat spot is molded into the case. If you get the connections backwards, the LED will glow when you try to charge the unit and you won't be able to go above about two volts.

Cut a 3-inch-diameter disc out of a piece of Index card. Punch a hole in the center of the disc the same diameter as LED1. Dimensions for the disc are shown in Fig. 6. The disc will

act as a sunshade to keep C1 from becoming too warm. Remember, the capacitor's leakage current will rise with temperature.

Mount the dosimeter on a stick such as a 1/4-inch wood dowel that is about a foot long, using white masking tape to hold the capacitor in place. That way, the dosimeter can be "planted" in the ground and away from the heat of the soil. The sunshade is placed over LED1 so that C1 is always shaded. The final assembly is shown in Fig. 7.

**Calibration.** Pick a bright, sunny day to calibrate the dosimeter, preferably at noon when the sun is directly overhead; intense sunlight is needed. Charge the dosimeter for at least an hour before measuring its voltage. Charging the dosimeter is done in the same way that the capacitor was tested for leakage: a 10,000-ohm resistor in series with a 12- to 18-volt battery. Place the dosimeter in the sun with the flat surface (cathode) of LED1 facing the sun's direction of travel and note the time. After one hour or more, measure the voltage across C1, recording that along with the time. The difference in voltage divided by the difference in time will tell you how many volts per hour the dosimeter registers in bright sunlight. We'll call that ratio the *exposure constant*. To measure the number of hours of sunlight that a spot receives in a day, measure the change in voltage and dividing it by the exposure constant.

**Troubleshooting.** The solar dosimeter is based on commonly-available parts and some basic physics. What if it doesn't work as advertised? The green LED is inexpensive; if one doesn't work satisfactorily, try another one. Some LEDs might be more efficient photodiodes than others, causing the capacitor to run out of charge before the day is over. Some capacitors have less actual capacitance than marked on the can, causing the same problem. In either case, you can reduce the rate at which the voltage drops by either using two capacitors in parallel or putting a neutral filter over the LED. Such a filter can be made from a few layers

of clear tape, a thin layer of white nail polish, or placing the dosimeter into a white plastic film canister.

If you've used a capacitor with a higher voltage rating, you can charge the capacitor up to a higher voltage to start off with. If you've been using a 12-volt source, try seasoning the capacitor at 18 volts.

If the capacitor has too much leakage, that is, it self-discharges by more than a volt in twelve hours, try charging it to a lower voltage initially, or season it longer at about 100 degrees F.

Do not let moisture get between the capacitor terminals. Dew or rain

### PARTS LIST FOR THE SOLAR DOSIMETER

- LED1—Light-emitting diode, green, T-1 1/4 size, diffused lens. (Mouser 351-5023, RadioShack 276-022 or similar)
- C1—2200-μF, 16-WVDC, electrolytic capacitor, low-leakage, radial leads
- R1—10,000-ohm, 1/4-watt, 5% carbon resistor
- B1—12-volt battery
- Wooden dowel, tape, etc.

will cause the capacitor to discharge rapidly. Place the dosimeter in a watertight enclosure, such as the 35-mm film canister mentioned earlier, if that is a problem.

**Sample Applications.** Suppose you have a southeast-facing sloped roof on your house, and you are wondering how well a photovoltaic array would work, mounted in that same orientation. Simply orient the solar dosimeter with its flat surface parallel to the roof and expose it for a full day. Measure the change in voltage and you have a number equivalent to the amount of ampere-hours a photovoltaic array will put out. Compare that with how much the dosimeter registers with different orientations and angles, and you'll know if odd-angle mounting or tracking mechanisms are worth the extra complexity and expense.

An unusual location to mount the solar dosimeter is inside a hat. The LED could be mounted on a small hole punched in the brim with C1 taped underneath with the leads bent at a right angle.

A final note on sun exposure:

(Continued on page 83)



# Twinkle, Twinkle, Little Lights, and More

LET'S TAKE A LOOK AT SOMETHING SO OLD AND SO SIMPLE THAT IT JUST MIGHT BE NEW FOR YOU. AT ANY RATE, THIS IDEA STILL MAKES A SELDOM-SEEN AND A REALLY FINE LITTLE HOMEBREW PROJECT...

## Twinkle Lights

In my opinion, the NE-2 neon lamp is by far the number-one electronic component of all time. Yes, the device is more or less way into retirement due to the high voltages needed and its restricted light output. But you can still get them for a dime or so each at Radio-Shack and elsewhere, and nothing else even comes remotely close to its versatility or its elegant simplicity.

In its prime, that good old NE-2 served as everything from...

panel lamps  
electronic organs  
surge protectors  
voltage regulators  
polarity finders  
AC-DC voltmeters  
display decorations  
proximity devices  
AND-OR logic  
flash triggers  
strobe lights  
computer memories  
flame monitors  
lamp dimmers  
touch sensors  
signal sources  
flip-flop latches  
frequency dividers  
"hot chassis" checkers  
audio oscillators  
vacuum tube testers  
radiation detectors

...and an awful lot more.

The NE-2 is just a small glass tube with a tiny amount of low-pressure neon gas in it. Two simple pins act as terminals. At voltages below 55 volts or so, the neon lamp is more or less an open circuit. Above that value, the tube "turns on" and starts to conduct, emitting a dis-

tinctive orange light.

When conduction starts, the NE-2 becomes a negative resistance. This happens as more current ionizes more gas in the plasma and lowers the drop across the terminals to (typically) 45 volts or so. That destructive behavior requires external current limiting, usually with a high-value resistor of 100K or more. Conduction continues as long as a current source remains. When and if the current drops down to zero, the neon lamp turns off.

A standard NE-2 pilot light circuit is shown in Fig. 1A. Connect that circuit

t o

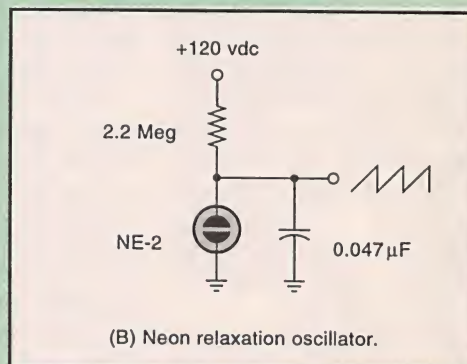
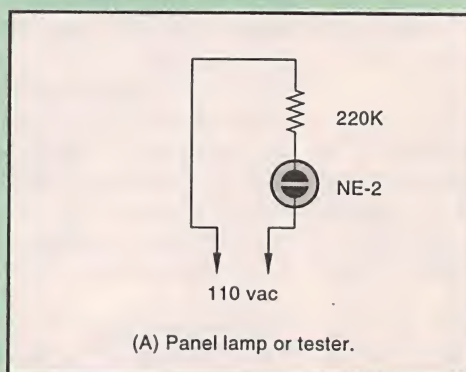


FIG. 1—TWO NEON LAMP CIRCUITS: The one in A is a simple lamp tester; the one in B is a relaxation oscillator.



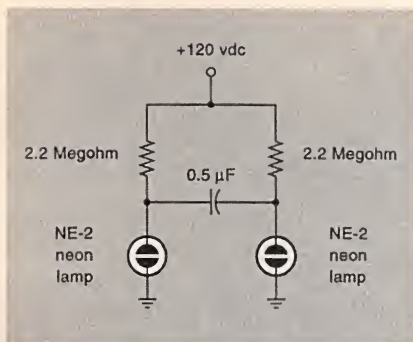


FIG. 2—A NE-2 SEQUENTIAL FLASHER, otherwise known as an astable multivibrator.

110-volts AC and both pins will light up to that characteristic neon orange. Once again, external current limiting must be provided, or a NE-2 will self-destruct. A variation on the circuit is the standard hardware store "circuit tester." Both lamp pins light on AC, but only the positive one does on DC. Thus, you have a simple AC-DC and polarity detector.

Another long-forgotten trick with the circuit checker is to use it as a hot-chassis detector. In some consumer-electronics equipment, one side of the line cord is connected to an internal chassis. Supposedly, the polarized prongs of the power cord prevent the wrong side from being connected, but mistakes do happen.

A severe shock hazard can exist when you try to service hot-chassis gear. To find out if what you are working on is of that type just hold one terminal of a neon tester in your hand and then touch the other to the chassis. If the lamp weakly lights, reverse the power cord or take other suitable precautions. No shock should be felt.

A simple neon-lamp relaxation oscillator is shown in Fig. 1B. That two megohm resistor by itself cannot provide enough current to light the neon lamp in this circuit. So, the lamp remains off, and the capacitor starts charging. When the capacitor charges up to 55 volts, the neon lamp turns on and flashes brightly.

The capacitor is then discharged to the lamp's turnoff point, and the cycle repeats. The lamp flashes at a frequency determined by the RC time constant and the thresholds involved. A sawtooth-like exponential wave will appear across the capacitor; it can be sensed and used as an audio or other signal source.

Neon circuits are also micropower because only a very few microamps are needed from your DC supply.

In Fig. 2, a pair of neon lamps is used as an alternating flasher. This was once known as an astable multivibrator. The capacitor first charges right-to-left and then left-to-right as the alternate lamps conduct. The secret to startup involves the small stray capacitances that are inherently around each bulb.

Figure 3 gives you a cute neon twin-kle light effect. Long ago and far away, I used this many times for dance decorations.

Due to the differences in lamp thresholds, the sequence ends up pretty much random—hence your twinkle lights or "little stars." At any given time, one (or rarely two) lamps are lit and provide capacitor charging paths. As the capacitors charge, the threshold for another lamp is exceeded and it fires. Because of a commutation effect, any other lamp turning on should turn off any already lit ones.

For relaxation oscillators to work, the resistors and supply voltage must all be chosen to lie on the negative resistance portion of the NE-2 curve. This usually happens over a rather wide value range. Some cut-and-try may be needed for anything fancy. Resistors in the one to four megohm range are usually a good starting point.

What is really mind-blowing is that I still know of no way to do the same thing using LEDs that can end up being remotely as simple, as cheap, or as low in power. Much more on elegant simplicity appears in ELESIMP.PDF on my [www.tinaja.com](http://www.tinaja.com) Web site.

## Tachometer Fundamentals

A tachometer is an instrument to measure the speed of a rotating shaft. The results are often shown in rpm, short for Revolutions per Minute.

Tachometers, or tachs, could be digital or analog. Generally, digital ones are more accurate but can be much harder to read and interpret, especially during changes. Since there are lots of subtle

## NEED HELP?

Phone or write all your US Tech Musings questions to:

Don Lancaster  
Synergetics  
Box 809-EN  
Thatcher AZ, 85552  
Tel: 520-428-4073

US email: [don@tinaja.com](mailto:don@tinaja.com)  
Web page: <http://www.tinaja.com>

## new from DON LANCASTER

### ACTIVE FILTER COOKBOOK

The sixteenth (!) printing of Don's bible on analog op-amp lowpass, bandpass, and highpass active filters. De-mystified instant designs. \$28.50

### RESEARCH INFOPACKS

Don's instant cash-and-carry flat rate consulting service. Ask any reasonable technical question for a detailed analysis and complete report. See [www.tinaja.com/info01](http://www.tinaja.com/info01) for specifics. \$79.00

### CMOS AND TTL COOKBOOKS

Millions of copies in print worldwide. THE two books for digital integrated circuit fundamentals. About as hands-on as you can get. \$28.50 each.

### INCREDIBLE SECRET MONEY MACHINE II

Updated 2nd edition of Don's classic on setting up your own technical or craft venture. \$18.50

### LANCASTER CLASSICS LIBRARY

Don's best early stuff at a bargain price. Includes the CMOS Cookbook, The TTL Cookbook, Active Filter Cookbook, PostScript video, Case Against Patents, Incredible Secret Money Machine II, and Hardware Hacker II reprints. \$119.50

### LOTS OF OTHER GOODIES

Tech Musings V or VI	\$24.50
Ask the Guru I or II or III	\$24.50
Hardware Hacker II, III or IV	\$24.50
Micro Cookbook I	\$19.50
PostScript Beginner Stuff	\$29.50
PostScript Show and Tell	\$29.50
PostScript Video & secrets	\$29.50
PostScript Reference II	\$34.50
PostScript Tutorial/Cookbook	\$22.50
PostScript by Example	\$32.50
Understanding PS Programming	\$29.50
PostScript: A Visual Approach	\$22.50
PostScript Program Design	\$22.50
Thinking in PostScript	\$22.50
LaserWriter Reference	\$19.50
Type 1 Font Format	\$16.50
Acrobat Reference	\$24.50
Whole works (all PostScript)	\$380.00
Technical Insider Secrets	FREE

### BOOK-ON-DEMAND PUB KIT

Ongoing details on Book-on-demand publishing, a new method of producing books only when and as ordered. Reprints, sources, samples. \$39.50

### THE CASE AGAINST PATENTS

For most individuals, patents are virtually certain to result in a net loss of sanity, energy, time, and money. This reprint set shows you Don's tested and proven real-world alternatives. \$28.50

the CMOS Cookbook, The TTL Cookbook, Active Filter Cookbook, PostScript video, Case Against Patents, Incredible Secret Money Machine II, and Hardware Hacker II reprints. \$119.50

### LOTS OF OTHER GOODIES

Tech Musings V or VI	\$24.50
Ask the Guru I or II or III	\$24.50
Hardware Hacker II, III or IV	\$24.50
Micro Cookbook I	\$19.50
PostScript Beginner Stuff	\$29.50
PostScript Show and Tell	\$29.50
PostScript Video & secrets	\$29.50
PostScript Reference II	\$34.50
PostScript Tutorial/Cookbook	\$22.50
PostScript by Example	\$32.50
Understanding PS Programming	\$29.50
PostScript: A Visual Approach	\$22.50
PostScript Program Design	\$22.50
Thinking in PostScript	\$22.50
LaserWriter Reference	\$19.50
Type 1 Font Format	\$16.50
Acrobat Reference	\$24.50
Whole works (all PostScript)	\$380.00
Technical Insider Secrets	FREE

### BOOK-ON-DEMAND PUB KIT

Ongoing details on Book-on-demand publishing, a new method of producing books only when and as ordered. Reprints, sources, samples. \$39.50

### THE CASE AGAINST PATENTS

For most individuals, patents are virtually certain to result in a net loss of sanity, energy, time, and money. This reprint set shows you Don's tested and proven real-world alternatives. \$28.50

### BLATANT OPPORTUNIST I

The reprints from all Don's Midnight Engineering columns. Includes a broad range of real world proven coverage on small scale technical startup ventures. Stuff you can use right now. \$24.50

### RESOURCE BIN I

A complete collection of all Don's Nuts & Volts columns to date, including a new index and his master names and numbers list. \$24.50

### FREE SAMPLES

Check Don's Guru's Lair at <http://www.tinaja.com> for interactive catalogs and online samples of Don's unique products. Searchable reprints and reference resources, too. Tech help, hot links to cool sites, consultants. email: [don@tinaja.com](mailto:don@tinaja.com)  
FREE US VOICE HELPLINE VISA/MC

### SYNERGETICS

Box 809-EN  
Thatcher, AZ 85552  
(520) 428-4073

FREE catalog: <http://www.tinaja.com>



## NAMES & NUMBERS

### Hitachi

2000 Sierra Point Pkwy.  
Brisbane, CA 94005  
(415) 589-8300

### Home Automation Systems

17171 Daimler Street  
Irvine, CA 92614  
(800) 367-9836

### Home Automator

2258 Sandy Lane  
Mebane, NC 27302  
(910) 578-9519

### Live Wire Enterprises

PO Box 670081  
Flushing, NY 11367  
(718) 544-4400

### Maxim

120 San Gabriel Dr.  
Sunnyvale, CA 94086  
(800) 998-8800

### P-O-P & Sign Design

7400 Skokie Blvd.  
Skokie, IL 60077  
(708) 675-7400

### Point of Purchase

6225 Barfield Rd. #200  
Atlanta, GA 30328  
(404) 252-8831

### Sign Business

1008 Depot Hill Office Pk.  
Broomfield, CO 80020  
(303) 469-0424

### SignCraft

PO Box 06031  
Ft. Myers, FL 33906  
(813) 939-4644

### Synergetics

Box 809  
Thatcher, AZ 85552  
(520) 428-4073

### Technical Works

PO Box 3692  
Albany, GA 31706  
(912) 787-3000

### Texas Instruments

PO Box 655303  
Dallas, TX 75380  
(800) 336-5236

"gotchas" to tach design, I thought we might go over some fundamentals. Digital tach design can often be split into sensing, conditioning, algorithmic conversion, and display:

**Sensing**—Sensing involves generat-

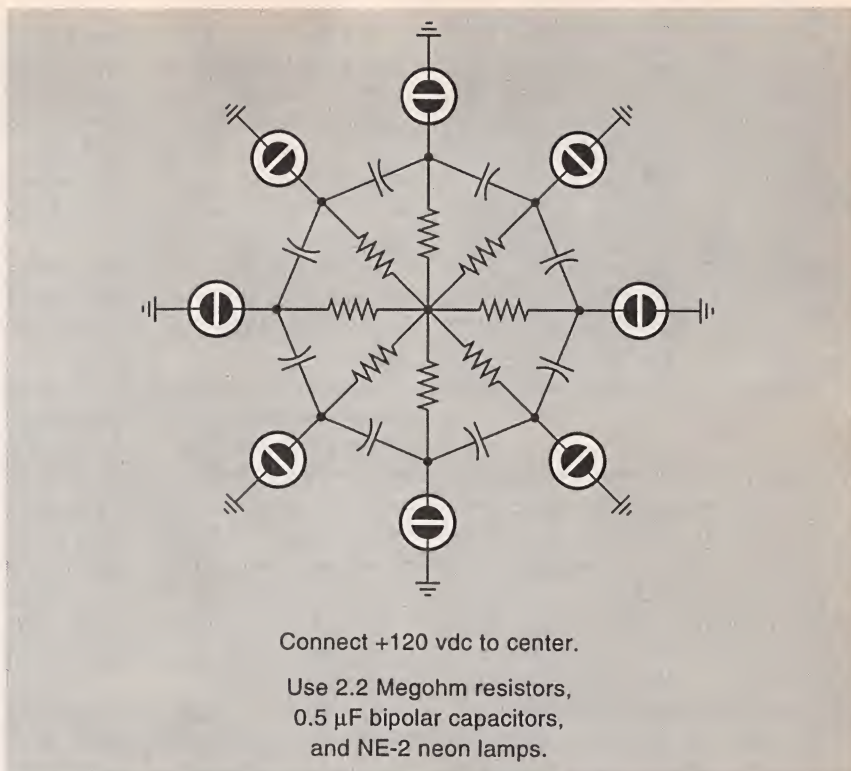


FIG.3—"TWINKLE LIGHTS" for a dance, show, or display.

ing one or more pulses per revolution. In "sensorless" sensing, speed signals are extracted and conditioned directly from the motor's back emf. This has to be tightly integrated into the exact motor and controller in use.

In "sensored" sensing, a device is placed on or near the motor shaft to generate one or more electric pulses per shaft revolution. Sensored sensing most often is done magnetically or optically.

Magnetic sensing is usually done with magnets and Hall Effect devices, or alternately by using ferrous gear teeth and variable reluctance coils. With infrared optics, a bladed vane could interrupt a LED/photodetector pair, or IR light could be bounced off reflective shaft portions.

A third route of very questionable reliability is to use direct mechanical contacts in a commutator setup or a physical gear or roller.

Note that speed can be determined using a single sensor. But when both speed and direction are needed, then a pair of quadrature sensors must be used. These are arranged so that one is in the middle of its sensing activity while the other is at its edge. A dual flip-flop or a computer-logic circuit can extract both speed and direction, as could a somewhat trivial software algorithm. Actual

position could be found by adding up or integrating all your speed pulses.

Honeywell and Allegro Electronics are major suppliers for low cost Hall sensors. Optoelectronic providers include Hewlett-Packard, Texas Instruments, Toshiba, Siemens, and QT Optoelectronics.

**Conditioning**—This just consists of making sure that each sensed pulse ends up as a single clean event. It can be done using hardware, software, or a mixture of both.

**Algorithmic conversion**—This step usually has to solve several interface problems. It might include numeric translations and reaching acceptable measurement speeds.

At 600 rpm with a single pulse per revolution, you'll have 10 pulses per second. The "10" result from a direct one second measurement must be multiplied by "60" to provide a "600" display. Other scaling factors need to be considered when more than one pulse per revolution is involved, or in automotive applications where each cylinder fires only once for every two revolutions. Note that certain newer cars may fire their cylinders twice to eliminate a distributor—once for real and once at a uselessly wrong time, so watch that detail.

Scaling can be done with hardware or software. These days, software scaling



## TACHOMETER RESOURCES

**Abbeon Cal**  
123 Gray Ave.  
Santa Barbara, CA 93101  
(805) 966-0810

**Allegro Microsystems**  
Box 15036  
Worcester, MA 01605  
(508) 853-5000

**Asian Sources**  
1020 Church St.  
Evanston, IL 60201  
(847) 475-1900

**Barbara Arnold Sales**  
3704 Carlisle Ct.  
Modesto, CA 95356  
(800) 335-4852

**Circuit Cellar Ink**  
4 Park St. #20  
Vernon, CT 06066  
(203) 875-2751

**Scott Edwards**  
964 Cactus Wren Lane  
Sierra Vista, AZ 85635  
(520) 459-4802

**Electromatic Equipment**  
600 Oakland Avenue  
Cedarhurst, NY 11516  
(800) 645-4330

**Hewlett-Packard**  
PO Box 10301  
Palo Alto, CA 94303  
(415) 857-1501

**Honeywell Microswitch**  
3660 Technology Dr.  
Minneapolis, MN 55418  
(800) 345-6770

**Measurement & Control**  
2994 W Liberty Ave.  
Pittsburgh, PA 15216  
(412) 343-9666

**Microchip Technology**  
2355 W Chandler Blvd.  
Chandler, AZ 85224  
(602) 786-7200

**Frank Murphy Mfg.**  
PO Box 470248  
Tulsa, OK 74147  
(918) 627-3550

**Omega Engineering**  
One Omega Dr.  
Stamford, CT 06907  
(800) 826-6342

**Parallax**  
3805 Atherton Rd. #102  
Rocklin, CA 95765  
(916) 624-8333

**QT Optoelectronics**  
610 N Mary Ave.  
Sunnyvale, CA 94086  
(408) 720-1440

**Red Lion Controls**  
20 Willow Springs Circle  
York, PA 17402  
(717) 767-6511

**Reddington Counters**  
130 Addison Rd.  
Windsor, CT 06095  
(860) 688-6205

**Sensors**  
174 Concord St.  
Peterborough, NH 03458  
(603) 924-9631

**Siemens Components**  
2191 Laurelwood Rd.  
Santa Clara, CA 95054  
(408) 980-4500

**Sunshine Instruments**  
1810 Grant Avenue  
Philadelphia, PA 19115  
(800) 343-1199

**TES Electronics**  
57 Jen-Ai Road SEc 2  
Taipei, TAIWAN  
886-2-2393-9142

**Texas Instruments**  
PO Box 655303  
Dallas, TX 75380  
(800) 336-5236

**Toshiba**  
1220 Midas Way  
Sunnyvale, CA 94086  
(800) 321-1718

**Veeder Root**  
125 Powder Forest Dr.  
Simsbury, CT 06070  
(860) 651-2700

phase-locked loop (such as a CMOS 4046) to "multiply" the input-pulse repetition rates by a reasonable selected numeric value. Such a multiplication might also perform the required scaling as well. However, there is an inherent lag in any PLL circuit, which might cause the display to unacceptably fall behind real-time speed changes.

An often optimum workaround is to measure the time period between the sensed pulses instead of counting their frequency. This is known as the EPUT method, as in Events Per Unit Time. The once-horrendous nasty involved here is that a 1/x calculation is required. If your chosen micro has no division instructions, alternates such as a table lookup or a repeated subtraction can be used. Scaling can also be provided internal to your 1/x calculation process.

Another algorithmic consideration is the update time as continuous updates tend to jump around and can be incredibly difficult to interpret or follow. Something near two to four updates per second is often a good choice that optimizes human factors. It's also a very good idea to take the average of as many measurements as practical before displaying them. It is sometimes optimum to round all the display values off to the nearest 100 revolutions per minute.

In certain circumstances, it is best to provide for both an analog and a digital speed display. Use digital for accuracy and analog to interpret any sudden changes.

**Display**—A PIC or other micro can be used for input conditioning, scaling, and algorithmic conversion. This will often drive an LCD or LED display. An LCD display might typically carry its own very specialized controller chip strapped onto its back.

## Some Resources

I've gathered together some tachometer information for you as this month's resource sidebar. Your best starting points are usually the *Sensors* or *Measurements & Control* trade journals. Lab tachs are resold by Omega Engineering, Abbeon Cal, and others.

Three examples of handheld tachs include the TouchTach by Barbara Arnold Sales, the Shippo DT-105 from Sunshine Instruments, and the RM-1500 from TES Electronics.

Ready-to-use digital-tach panel instruments are widely available. A pair of useful sources includes Red Lion and Reddington. Check out the latter's Eagle

using a PIC or other micro is the preferred choice.

Again, at 600 rpm using a single pulse per revolution, you'll have 10 pulses per second. Six seconds would be required to achieve a ten percent accu-

rate measurement. Much longer times would be required for higher accuracy, especially at lower speeds.

One obvious solution to response times is to have more sensed pulses per revolution. A second solution is to use a



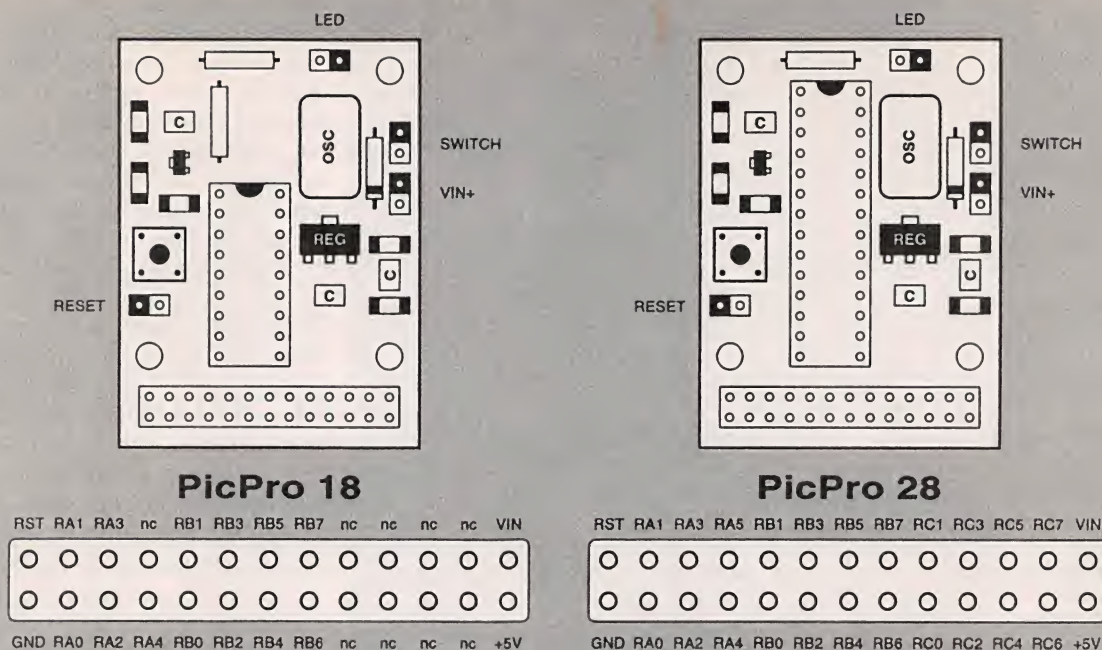


FIG. 4—THESE PICPRO BREADBOARDS from Technical Works simplify PIC design and interface.

Model 53.

One obvious starting point for any custom tachometer is to use the Basic Stamp from Parallax combined with an LCD display module from Scott Edwards Electronics. Later these can be replaced with a custom PIC or a baby PIC design and cheaper display. Microchip Technology is your main PIC supplier. Alternate solutions are offered by Circuit Cellar, as well as in most of the "hobby projects" kit-product lines. But unless you are up to something special, the commercial high volume modules are likely to be a better and cheaper solution than homebrew.

## PIC Development Boards

Speaking of PICs, Brad Mock of Technical Works has just come up with something that has long been needed—some small printed circuit breadboards that hold your choice of popular PIC chips, along with all the necessary regulator, oscillator, reset circuitry, and related goodies. Unlike the Basic Stamp from Parallax, these conveniently let you work directly in ultra fast PIC machine language. Two current models are for the 18- and 28-pin PIC chips; other sizes are in the works.

The list prices will be \$17.95. His special introductory price of \$14.95 is available for readers of this column. Several more details on these PicPro

devices are shown in Fig. 4. Lots more PIC information can be downloaded at [www.tinaja.com/picup01.html](http://www.tinaja.com/picup01.html).

## New Tech Lit

From Texas Instruments there's Radio Frequency Solutions and Video Solutions for PC Platforms mailers. From Maxim comes the latest release of a Data Catalog CD. The new reference library CD from Hitachi is about their SuperH RISC Engines

There is a new freebie catalog out from Home Automation Systems. And *Home Automator* magazine remains your first choice for useful help in this field. A home-automation tutorial is at [www.tinaja.com/resbn01.html](http://www.tinaja.com/resbn01.html).

I came across two interesting new books this month. First, be sure to check out *When Things Start to Think* by Neil Gershenfeld. This text is mostly on ongoing projects by the MIT Media Lab. Neil makes heavy predictions for the widespread use of low-cost distributed intelligence: everything from erasable digital paper to smart shoes. This title meshes nicely with *The Age of Intelligent Machines*, which we looked at last month.

There is also a superb *Planetary Astronomy* text by a Ronald Schorn. This appears to be a highly readable and a definitive history of our solar system discoveries as written by a NASA insider.

Lots of references and a detailed and annotated bibliography are nicely included.

More on these titles can be found at [www.tinaja.com/amlik01.html](http://www.tinaja.com/amlik01.html). A very useful database for astronomy teaching materials can be obtained from [www.aas.org/~education/index1.html](http://www.aas.org/~education/index1.html).

An intriguing "Knotty Neon" lighting and display material is now available. These are basically knottable "ropes" of electroluminescent light. There's ten colors with lengths up to 600 feet. The colors are somewhat adjustable by changing the applied frequency from a 12-volt AC control unit driven by a wall wart supply. The supplier is Live Wire Enterprises. I was unable to locate their Web site (if one exists). They are mentioned at [www.led.com](http://www.led.com) and at [www.lightsearch.com](http://www.lightsearch.com). Trade journals that target this sort of neat stuff include *Signcraft*, *Sign Business*, *POP and Sign Design*, and *Point of Purchase*.

There sure is a bunch of interest in boat anchors—pieces of ancient military surplus communications or test gear that are outrageously huge and heavy—these days. They sure don't make them like this any more. I will try to do an in-depth survey sometime, but for now, check into the link farm at [nashville.net/~badger/millist](http://nashville.net/~badger/millist). Or to find "straight from the horse's whatever" information, try out FM 24-24 at



www.gordon.army.mil/doctrine/2424, plus, of course, good old Surplus Al at mh105.infi.net/~surplsal/.

Speaking of boat anchors, I just happen to have a stunning buy on a neat 60-kilowatt load bank. AC or DC, single or three phase, 12 to 440 volts. You use this one for generator testing, student power-lab loads, or wind energy research. It also makes toast. And, no, there is no way you can call this one a white elephant—it is a perfectly normal gray elephant in color and size. Contact me via e-mail at don@tinaja.com or see www.tinaja.com/bargte01.html.

For all the fundamentals of digital integrated circuits, be sure to check into my *TTL and CMOS Cookbooks*, either by themselves or as part of my bargain priced *Lancaster Classics Library*. See my nearby Synergetics ad for full details. And for all your other book needs, see www.tinaja.com/amlink01.html.

The latest Web-site additions to my Guru's Lair found at www.tinaja.com include a tutorial on Supraluminal Dowsing for Brown's Gas in Roswell. Your key secret, of course, is to be sure to use an overunity water-fueled black helicopter.

Our Consultant's Network is newly expanded and greatly improved at www.tinaja.com/consul01.html. And lots of surplus bargains are found at www.tinaja.com/barg01.html.

As usual, most of these mentioned items should show up in our Names & Numbers or Tachometer Resources sidebars. Check here before calling our no-charge US technical helpline shown in the nearby box.

Let's hear from you.

EN

## SOLAR DOSIMETER

(continued from page 77)

Note that the solar dosimeter responds only to the blue-green portion of the visible spectrum; it does not directly measure ultraviolet radiation. You can use it, however, to estimate your UV exposure in the six hours around noon when UV intensity is proportional to visible radiation. Also note that due to the nature of the Earth's atmosphere, the amount of visible light is not necessarily an accurate indicator of the amount of UV radiation.  $\Omega$

# Electronics NOW

## REPRINT BOOKSTORE

- |   |  |
|---|--|
| <input type="checkbox"/> 229 Popular Electronics (1999 back issues) \$5.00<br>Write in Issues desired _____ | <input type="checkbox"/> 218 Electronics Now (1998 back issues) \$5.00<br>Write in Issues desired _____            |
| <input type="checkbox"/> 228 Popular Electronics (1998 back issues) \$5.00<br>Write in Issues desired _____ | <input type="checkbox"/> 217 Electronics Now (1997 back issues) \$5.00<br>Write in Issues desired _____            |
| <input type="checkbox"/> 227 Popular Electronics (1997 back issues) \$5.00<br>Write in Issues desired _____ | <input type="checkbox"/> 216 Electronics Now (1996 back issues) \$5.00<br>Write in Issues desired _____            |
| <input type="checkbox"/> 226 Popular Electronics (1996 back issues) \$5.00<br>Write in Issues desired _____ | <input type="checkbox"/> 215 Electronics Now (1995 back issues) \$5.00<br>Write in Issues desired _____            |
| <input type="checkbox"/> 225 Popular Electronics (1995 back issues) \$5.00<br>Write in Issues desired _____ |  |
| <input type="checkbox"/> EH96 Experimenters Handbook (1996) \$5.00  | <b>REPRINTS      REPRINTS</b>  |
| <input type="checkbox"/> EH95S Experimenters Handbook<br>Summer Edition (1995) \$5.00                       | <input type="checkbox"/> 174 Electronics Cartoons (The Best of) \$1.99   |
| <input type="checkbox"/> EH94S Experimenters Handbook<br>Summer Edition (1994) \$5.00                       | <input type="checkbox"/> 173 From Not-Working to Networking<br>Troubleshooting Local-Area Networks \$2.99          |
| <input type="checkbox"/> EH94W Experimenters Handbook<br>Winter Edition (1994) \$5.00                       | <input type="checkbox"/> 172 33 Bench-Tested Circuits \$1.99   |
| <input type="checkbox"/> EH94 Experimenters Handbook (1994) \$5.00  | <input type="checkbox"/> 171 36 Time Tested Circuits \$1.99  |
| <input type="checkbox"/> EH93 Experimenters Handbook (1993) \$5.00  | <input type="checkbox"/> 170 High-Voltage Project for Fun and<br>Science Book 1 \$2.99                             |
| <input type="checkbox"/> HH95S Hobbyists Handbook<br>Spring Edition (1995) \$5.00                           | <input type="checkbox"/> 170A High-Voltage Projects for Fun and<br>Science Book 2 \$2.99                           |
| <input type="checkbox"/> HH95F Hobbyists Handbook<br>Fall Edition (1995) \$5.00                             | <input type="checkbox"/> 169 Think Tank (133 Circuits) \$1.99  |
| <input type="checkbox"/> HH94S Hobbyists Handbook<br>Spring Edition (1994) \$5.00                           | <input type="checkbox"/> 169A Think Tank Vol. 2 \$1.99   |
| <input type="checkbox"/> HH94F Hobbyists Handbook<br>Fall Edition (1994) \$5.00                             | <input type="checkbox"/> 168 Fact Cards (#34-66) \$1.99  |
| <input type="checkbox"/> HH93 Hobbyists Handbook (1993) \$5.00  | <input type="checkbox"/> 168C Fact Cards (#67-99) \$1.99   |
| <input type="checkbox"/> HISTORY Crystal Radio History, Fundamentals<br>& Design \$10.95                    | <input type="checkbox"/> 168D Fact Cards (#100-132) \$1.99   |
| <input type="checkbox"/> XTAL Crystal Set Handbook \$10.95  | <input type="checkbox"/> 167 Designing With IC's \$2.99  |
| <input type="checkbox"/> XTALPRO Crystal Set Projects \$14.95   | <input type="checkbox"/> 166 Collected Works of Mohammed Ullyses<br>Fips (62 pages, April Fools Collection) \$6.99 |
| <input type="checkbox"/> XTALBLD Crystal Set Building \$15.95   | <input type="checkbox"/> 165 How to Repair CD Disc Players \$2.99  |
| <input type="checkbox"/> POP96 POPtronix Hobbyist Handbook (1996) \$5.00                                    | <input type="checkbox"/> 164 Modern Electrics (April 1908) \$1.99  |
| <input type="checkbox"/> POP97 POPtronix Exper Handbook (1997) \$5.00                                       | <input type="checkbox"/> 160 New Ideas - 42 Circuits \$1.99  |
| <input type="checkbox"/> Radiocraft 1993 Projects for Hobbyists \$5.00                                      | <input type="checkbox"/> 159 Low Frequency Receiving Techniques<br>Building and Using VLF Antennas \$2.99          |
| <input type="checkbox"/> 219 Electronics Now (1999 back issues) \$5.00<br>Write in Issues desired _____     | <input type="checkbox"/> 158 Electro Importing Co. Catalog<br>(Circa 1918) \$2.99                                  |
|   | <input type="checkbox"/> 157 All About Kits \$1.99   |
|   | <input type="checkbox"/> 156 How To Make PC Boards \$1.99  |
|   | <input type="checkbox"/> 154 How To Repair VCR's \$1.99  |

To order any of the items indicated above, check off the ones you want. Complete the order form below, include your payment, check or money order (DO NOT SEND CASH), payable to and mail to Claggk Inc., Reprint Department, P.O. Box 4099, Farmingdale, NY 11735.

Please allow 4-6 weeks for delivery. No COD's!

To place a credit card by phone, Visa Mastercard or Discover only. You can also order and pay by e-mail. Contact Claggk@gernsback.com for details.

**CALL: 516-293-3751.**

**To use your Visa, Mastercard or Discover, complete the following:**

Bill my ☐ Visa ☐ Mastercard ☐ Discover

Card No. \_\_\_\_\_

Exp. Date \_\_\_\_\_

Signature \_\_\_\_\_

**MAIL TO: Claggk Inc.**

Reprint Bookstore, P.O. Box 4099, Farmingdale, NY 11735

SHIPPING CHARGES IN USA & CANADA

Up to \$5.00	\$2.00	\$30.01 to 40.00	\$6.00	Overseas Orders must contact CLAGGK for shipping charges.
\$5.01 to \$10.00	\$3.00	\$40.01 to 50.00	\$7.00	
\$10.01 to 20.00	\$4.00	\$50.01 and above	\$8.50	
\$20.01 to 30.00	\$5.00			

Total price of merchandise \$ \_\_\_\_\_

Shipping Charge (see chart) \$ \_\_\_\_\_

Subtotal \$ \_\_\_\_\_

Sales Tax (New York State Residents only) \$ \_\_\_\_\_

Name \_\_\_\_\_ Total Enclosed \$ \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

CL01



## NEW PRODUCTS

*continued from page 16*

gence and mobility to new and existing network video cameras by providing pan/tilt/zoom position control and viewing access from anywhere in the world. Easy to use and set up, the Transit RCM is connected into the camera with a tripod mount and then plugged into a PC serial port. Control of that camera can then be accessed from any PC connected to the digital network being used.



CIRCLE 22 ON FREE INFORMATION CARD

The camera mount provides accurate remote positioning control for new or existing CCD/CMOS video camera systems connected via digital networks. This controller increases the field-of-view of existing stationary video cameras (analog or digital) up to 270 degrees, depending on the camera used, and eliminates the need for low resolution "fisheye" lenses. The compact Transit RCM features control for motorized zoom, focus, and iris, and self-calibration upon reset. The Transit RCM has a suggested retail price of \$295.

### **SURVEYOR CORP.**

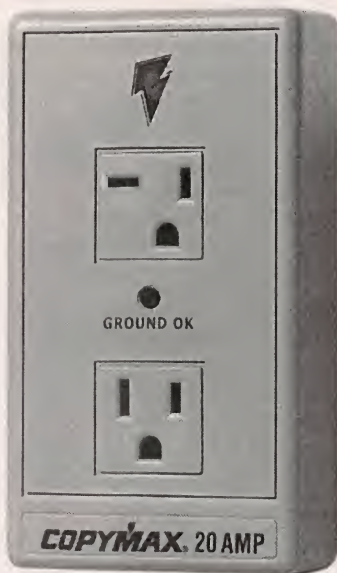
4501 Orcutt Road  
San Luis Obispo, CA 93401  
Tel: 805-784-9000  
Fax: 805-784-0925  
e-mail: [mjf@surveyorcorp.com](mailto:mjf@surveyorcorp.com)  
Web: [www.surveyorcorp.com](http://www.surveyorcorp.com)

### **Power Filter**

DESIGNED TO PROTECT DIGITAL multi-functional equipment, the COPYMAX 20 AMP power filter ensures a much greater degree of product safety. As well as meeting UL 1449

standards, the unit provides thermal fusing, which protects against fire in case of extended overvoltage. The unit includes surge protection circuitry with an enhanced power line filter design.

It uses both common and normal mode coils, adding suppression of noise



CIRCLE 23 ON FREE INFORMATION CARD

from connected equipment and provides noise filtration and increased noise and spike attenuation. The COPYMAX 20 AMP has two 20-amp outlets and plugs directly into the AC wall outlet. Diagnostic lights continuously monitor the status of the power being supplied, as well as the operation of the circuitry. The COPYMAX 20 AMP has a suggested list price of \$99.

### **PANAMAX**

150 Mitchell Blvd.  
San Rafael, CA 94903  
Tel: 800-472-5555 or 415-499-3900  
Fax: 415-472-5540  
Web: [www.panamax.com](http://www.panamax.com)

### **Air Cleaner Test Probe**

THE FLUKE 80K-15 ELECTRONIC Air Cleaner Test Probe is an accessory that extends the voltage measurement capability of most digital multimeters up to 15kV. It is intended for measuring the output voltage in low energy environments such as electronic air cleaners. The 80K-15 probe provides high accuracy ( $\pm 2\%$ ) when used with a voltmeter having an input impedance of 10 megohms.

Plastic body construction provides

the user with isolation and protection from the voltage being measured. A heavy-duty grounding clip offers a secure connection to earth ground. The



CIRCLE 24 ON FREE INFORMATION CARD

80K-15 probe has a suggested retail price of \$149.

### **FLUKE CORP.**

P.O. Box 9090  
Everett, WA 98206  
Tel: 800-44FLUKE  
Fax: 800-FLUKE-FAX  
e-mail: [fluke-info@tc.fluke.com](mailto:fluke-info@tc.fluke.com)  
Web: [www.fluke.com/handheld/access](http://www.fluke.com/handheld/access)

### **Recorder/Equalizer Interconnect Device**

USEFUL FOR SERIOUS RECORD collectors, sound restorers, and home studios, the SuperConnector is an easy-to-use, audiophile-quality device. It permits connection of up to five audio recorders and various equalizers to your main audio system. It can also connect



CIRCLE 25 ON FREE INFORMATION CARD

between your recorders for dubbing onto any or all of them.

The unit adds a mono mode control to facilitate recording mono sources, or to accommodate mono equalizers, or single channels of a source. External recorders can be conveniently connected via front-panel 1/4-inch stereo plugs. Made of high-quality, double-sided, fiber glass epoxy PCB, the equalizer features 34 gold-plated RCA connectors and is rack mountable. The SuperConnector sells for \$299.

### **ESOTERIC SOUND**

4813 Wallbank Ave.  
Downers Grove, IL 60515  
Tel: 630-960-9137  
e-mail: [esotericct@aol.com](mailto:esotericct@aol.com)



# NEW LITERATURE

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

## Steal This Computer Book: What They Won't Tell You About the Internet

by Wallace Wang  
No Starch Press

555 De Haro Street, Suite 250

San Francisco, CA 94107

Tel: 415-863-9900

Fax: 415-863-9950

Web: [www.nostarch.com](http://www.nostarch.com)

**\$19.95**

Computer viruses, hacking, phone phreaking, e-mail bombs—how do they work, who are the perpetrators, and how can you protect yourself from them? These issues, among others, are explored in this book. The author provides objective information that enables readers to become active, involved, educated Net-heads as opposed to passive victims.



CIRCLE 338 ON FREE INFORMATION CARD

In exposing the dangers of computer technology, this book reminds us that sometimes the best defense is a good offense. To help you protect yourself and your computer, the author takes a tour of the Internet and explains the secrets necessary for survival.

## Stompbox: A History of Guitar Fuzzes, Flangers, Phasers, Echoes & Wahs

by Art Thompson

Miller Freeman Books

6600 Silacci Way

Gilroy, CA 95020

Tel: 800-848-5594 or

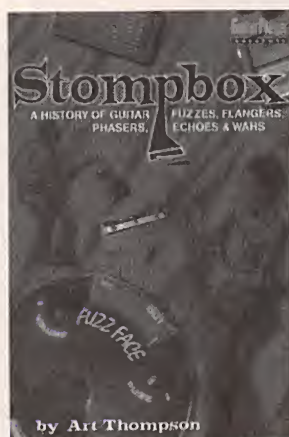
408-848-5296

Fax: 800-437-3299 or 408-848-5784

Web: [www.books.mfi.com](http://www.books.mfi.com)

**\$24.95**

This book tells the story of the electric guitar devices that rendered some of the most famous music of the 60s and beyond, such as the Stones' "(I Can't Get No) Satisfaction." Thousands of songs owe a huge debt to the small unit that distorts and sculpts guitar sound, creating outrageous effects.



CIRCLE 339 ON FREE INFORMATION CARD

The author portrays the stompbox in all its incarnations: fuzz boxes, wah-wah pedals, reverb and tremolo bars, talk boxes, echo units, and other guitar additions—mostly with crazy names like Fuzz Wah Diddy and Orange Squeezer—and accompanies the text with over 200 photos. He traces its roots back to the transistor and discusses how many of the old units have become very popular with today's guitarists.

## 1999 Master Catalog

from Jensen Tools, Inc.

7815 S. 46th Street

Phoenix, AZ 85044-5399

Tel: 800-426-1194 or 602-968-6231

Fax: 600-366-9662 or 602-438-1690

e-mail: [jensen@stanleyworks.com](mailto:jensen@stanleyworks.com)

Web: [www.jensentools.com](http://www.jensentools.com)

**Free**

This 308-page, full-color catalog con-

tains many new products including the recently introduced line of Jensen brand handheld meters. Among other new products are the TX Series DMMs from Tektronix, Fluke's i2000flex current probes, and Leatherman's Wave multi-purpose tool.



CIRCLE 340 ON FREE INFORMATION CARD

In addition to 50 pages of Jensen original tool kits, the new catalog features products from all major manufacturers, including test equipment, power and specialty tools, wire and cable, equipment for soldering, telecommunications, and much more. A complete alphabetical index is provided, listing products by manufacturer and type.

## Caller ID & ANI Security

by John J. Williams

Consumertronics

P.O. Box 23097

Albuquerque, NM 87192

Tel: 505-237-2073

Fax: 505-292-4078

Web: [www.tsc-global.com](http://www.tsc-global.com)

**\$29**

Want to keep your ID secret when calling? This manual details how Caller ID works and discusses the vulnerability of

**BooksNow** To order books in this magazine or, any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (801) 261-1187 ask for ext. 1454 or visit on the web at <http://www.BooksNow.com/electronicsnow.htm>.

Free catalogs are not available.



Caller ID, ANI, \*69, \*57, \*67, and Call Blocking. Other topics covered are Class Per-Call Services, Advantages and Disadvantages of Caller ID, Phone Privacy, and Technical Details.

## Regulation of Wireless Communication Systems

by Frederic J. Day and Huong N. Tram

Government Institutes

4 Research Place, Suite 200

Rockville, MD 20850

Tel: 301-921-2355

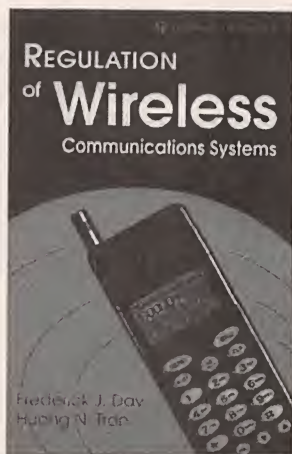
Fax: 301-925-0373

e-mail: [giinfo@govinst.com](mailto:giinfo@govinst.com)

Web: [www.govinst.com](http://www.govinst.com)

**\$89**

A valuable reference tool for researching FCC policies and regulations, this book provides an in-depth understanding of the regulations of wireless systems. Readers will get a critical analysis of the history and current status of FCC regulations, including the Telecommunications Act of 1996—an understanding of which is essential to successfully navigating your wireless communications business.



CIRCLE 341 ON FREE INFORMATION CARD

Easy-to-read, this sourcebook takes a comprehensive look at FCC regulations affecting wireless communications, such as private land mobile and microwave communication systems, and common carrier communication systems. Numerous charts, tables, and dia-

### BooksNow

To order books in this magazine or, any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (801) 261-1187 ask for ext. 1454 or visit on the web at <http://www.BooksNow.com/electronic-snow.htm>.

Free catalogs are not available.

grams help explain complex concepts, including the fundamentals of radio communications, frequency allocations, and "reframing the spectrum."

## DTV: The Revolution in Electronic Imaging

by Jerry Whitaker

McGraw-Hill

1221 Avenue of the Americas

New York, NY 10020

Tel: 800-2MCGRAW

Web: [www.ee.mcgraw-hill.com](http://www.ee.mcgraw-hill.com)

**\$55**

DTV combines the best available digital technologies for video and harnesses them for new uses in broadcast communications. This book provides complete background for every important innovation in this field.



CIRCLE 342 ON FREE INFORMATION CARD

Using explicit examples, schematics, and mathematics, the author creates a primer of DTV standardization—a blending of telecommunications, broadcasting, and computer technologies into one tool. The book also reports on video transmission issues and interchange formats. Other topics covered include video compression, convergence issues, and transmission and reception hardware.

## Newnes Data Communication Pocket Book, 3rd Edition

by Mike Tooley

Newnes, Butterworth Heinemann

225 Wildwood Avenue

Woburn, MA 01801-2041

Tel: 800-366-2665 or 781-904-2500

Fax: 800-446-6250

e-mail: [orders@bhusa.com](mailto:orders@bhusa.com)

Web: [www.bh.com/newnes](http://www.bh.com/newnes)

**\$28.95**

This edition has been substantially

updated and expanded to keep up with the latest developments in data communications technology. Among the topics covered are data compression, the Internet and the Web, and HyperText Mark-up Language (HTML).



CIRCLE 343 ON FREE INFORMATION CARD

Despite the complexity of the material, this information is presented clearly and concisely. Tables and diagrams help readers locate information quickly and easily.

## 1999 Catalog

from CAIG Laboratories, Inc.

12200 Thatcher Court

Poway, CA 92064-6876

Tel: 800-CAIG-123 or 619-486-8388

Fax: 619-486-8398

e-mail: [caig123@aol.com](mailto:caig123@aol.com)

Web: [www.caig.com](http://www.caig.com)

**Free**

CIRCLE 344 ON FREE INFORMATION CARD

This catalog features a variety of environmentally safe products to improve conductivity and maintain optimum signal quality on connectors, probes, switches, and other electrical contacts and connectors. CAIG offers a complete line of non-aerosol applicators for aerosol-sensitive customers.

Products include lubricants, deoxidizers, solvents, pastes, anti-static and shielding compounds, lint-free accessories, solder pots, plastic cutting and welding tools, heat-shrink ovens, process conveyor ovens, and more. **EN**



## SERVICE CLINIC

*continued from page 25*

either—it is external.

As stated early in this article, the ferrite core of a flyback transformer is constructed with a precision gap usually formed by some plastic spacers or pieces of tape—don't lose them if you need to disassemble the core. The ferrite core is also relatively fragile, so take care.

The focus and screen divider network uses potentiometers and resistors (not shown) with values in the tens to hundreds of megohms, so they may not register at all on your multimeter. The high voltage rectifiers (D1 to D3 on this diagram) are composed of many silicon diodes in series and will read open on a typical VOM or DMM.

Note that there is no standardization to the color code. However, the fat wire to the CRT is most often red, though it could also be black. Of course, you cannot miss it with the suction cup-like insulator at the CRT-anode end. The focus and/or screen connections may also be to pins rather than flying leads.

### Replacement Flyback Transformers

Unfortunately, you cannot walk into RadioShack and expect to locate a flyback for your TV or monitor. However, there are other options:

- Original manufacturer—most reliable source but most expensive. Older models may not be available. This may be the only option for many TVs and monitors—particularly expensive or less-popular models.

- Electronics distributors—a number of distributors sell replacement flybacks. However, there may be no way of knowing if what you are getting is an original replacement or a generic equivalent, and you could end up with something that isn't quite compatible (see below). Thus, unless the catalog listing says "original part," these may be no better than ones from the generic sources we'll detail shortly.

In your search for flybacks, here are some places to try:

Component Technologies, Tel: 888-FLYBACK or 800-878-0540; e-mail: [fbtxformer@aol.com](mailto:fbtxformer@aol.com)

CRC Components, Tel: 800-822-1272

EDI (Electro Dynamics, Inc.) NY, Tel: 800-426-6423

Data Display Ltd, Canadian sub of CCS, Tel: 800-561-9903

Global Semiconductors (Toronto, Canada), Tel: 800-668-8776, Web: [www.globalsemi.com](http://www.globalsemi.com)

- Generic replacements—ECG, NTE, ASTI, HR Diemen, for example, offer lines of replacement flybacks. These companies have sites on the Internet that include a cross reference to their replacement based on TV or monitor model and/or the part or house number on the flyback:

NTE Electronics: [www.ntelinc.com](http://www.ntelinc.com)

ECG Philips: [www.ecgproducts.com](http://www.ecgproducts.com)

HR Diemen: [www.hrdiemen.es](http://www.hrdiemen.es)

ASTI Magnetics:

[www.astimagnetics.com](http://www.astimagnetics.com)

Flybacktransformer:

[www.flybacktransformer.com](http://www.flybacktransformer.com)

Cactus Technology Corp.:

[www.flyback-transformer.com](http://www.flyback-transformer.com)

Note, however, that generic replacements might be of lower quality or be not quite compatible with your original. In an effort to minimize the number of distinct flyback models, some corners may be cut and one-size-fits-many may be the rule resulting in all sorts of problems that could even further complicate your troubleshooting. In short, turn to these only if availability or economics leave you with no other choice.

### Wrap Up

That's it for now. Next time we will continue our discussion of monitor troubleshooting and repair. Until then, check out my Web site, [www.repairfaq.org](http://www.repairfaq.org). I welcome comments (via e-mail only please at [sam@stdavids.picker.com](mailto:sam@stdavids.picker.com)) of all types and will reply promptly to requests for information. See you next time! **EN**

## COMPUTER CONNECTIONS

*continued from page 13*

work with your standard phone lines.

To take advantage of xDSL, you'll need to equip your computer with an appropriate modem—usually ADSL or SDSL. The difference between these two is that ADSL is designed to have more bandwidth for downloads, making it perfect for Web use, while SDSL has synchronized speeds in both directions, making it a great solution for videoconferencing and file uploads. Maximum speeds for xDSL are expected to be about 2 Mbps; this seems slower than

cable at first glance, but what you should know is that you'll get this speed on a regular basis and don't have to worry about bandwidth being used up by others someday (it's hard to say if cable companies will keep their promise of speed and bandwidth control).

### VENDOR INFORMATION

#### Compaq

20555 State 249  
Houston, TX 77070  
Tel: 800-345-1518  
Web: [www.compaq.com](http://www.compaq.com)

#### Hughes Network Systems (DirecPC)

11717 Exploration Lane  
Germantown, MD 20876  
Tel: 800-DirecPC  
Web: [www.direcpc.com](http://www.direcpc.com)

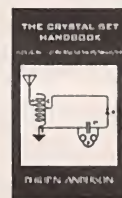
#### DSL Communications

4675 Stevens Creek Blvd.  
Suite 241  
Santa Clara, CA 95051  
Tel: 408-249-6400  
Web: [www.dsl-com.com](http://www.dsl-com.com)

As only a few areas are currently operating with the technology, xDSL's pricing is difficult to determine right now. From what we've seen, at its cheapest it's about \$60 a month—almost double the cost of cable. Keep a look out for xDSL announcements in your area in the coming months. Computer vendors like Compaq are already shipping machines with modems that can handle both xDSL and standard analog lines (check out their Presario 5600 line), and companies like DSL Communications are already shipping add-on modems for use with any computer.

That's all for now. Until next time, here's hoping you have a viable high-speed way to get on the Net. If you'd like to get in touch, you can send e-mail to [connections@gernsback.com](mailto:connections@gernsback.com), or snail-mail to *Computer Connections, Electronics Now*, 500 Bi-County Blvd., Farmingdale, NY 11735. **EN**

### Get your copy of the CRYSTAL SET HANDBOOK



Go back to antiquity and build the radios that your grandfather built. Build the "Quaker Oats" type rig, wind coils that work and make it look like the 1920's! Only \$10.95 plus \$4.00 for shipping and handling. Clagg Inc., P.O. Box 4099, Farmingdale, NY 11735. USA Funds ONLY! USA and Canada—no foreign orders. Allow 6-8 weeks for delivery. MA01



## ADVERTISING INDEX

Electronics Now does not assume any responsibility for errors that may appear in the index below.

Free Information Number	Page	Free Information Number	Page
— Abacom Technology .....	69	— James Electronics .....	58
— ABC Electronics .....	68	— KNS Instruments .....	52
— AES .....	62	— Lynxmotion .....	61
214 All Electronics .....	71	— M <sup>2</sup> L Electronics .....	52
— Allison Technology .....	69	325 Mark V Electronics .....	64
— Amazon Electronics .....	66	327 MCM Electronics .....	47
270 American Eagle Publications .....	46	306 Merrimack Valley Systems .....	62
— Andromeda Research .....	60	133 MicroCode Engineering .....	CV2
— Arrow Technologies .....	52	— microEngineering Labs .....	67
— Basic Electrical Supply .....	53	— Modern Electronics .....	64
— Brand Electronics .....	69	318 Mouser Electronics .....	52
— Bsoft Software, Inc. ....	62	— MSC Electronics .....	66
322 C&S Sales, Inc. ....	50	— NESDA .....	21
— Cable USA .....	68	— Netcom .....	53
— Circuit Specialists .....	53	262 Parts Express Inc. ....	55
— CLAGGK, Inc. ....	11, 83	— Pioneer Hill Software .....	60
— Cleveland Inst. of Electronics .....	33	222 Polaris Industries .....	45
— Command Productions .....	46	315 Prairie Digital .....	46
— Decade Engineering .....	67	264 Print (Pace) .....	63
— EDE - Spy Outlet .....	68	266 Ramsey Electronics .....	49
323 Electronix Express .....	54	283 Resources Unlimited .....	57
— Electronic Tech. Today .....	26, 44	— Securetek .....	67
— Emac Inc. ....	58	— Sil Walker .....	58
— Engineering Express .....	66	— Square 1 Electronics .....	56
335 Foley-Belsaw .....	59	— Super Circuits .....	52
— General Device Instruments .....	60	— Tech-Specialties .....	66
— Grantham Col. of Engineering .....	6	— Techniks .....	66
— Home Automation .....	60	— Technological Arts .....	66
— Howard Electronics .....	72	312 Telulex .....	56
331 Howard Electronics .....	65	333 Test Equipment Depot .....	48
— ICS .....	64	217 Test Equipment Sales .....	70
— Information Unlimited .....	48	275 Timeline .....	54
— Intec Automation .....	66	— Unbound .....	56
138 Interactive Image Technologies .....	CV4	— U.S. Cyberlab .....	68
319 IVEX Design .....	61	132 Windjammer Barefoot Cruises .....	6
— J&M Microtek, Inc. ....	67	— World Star Technologies .....	67
— J-Tron Inc. ....	66	— Worldwyde .....	66, 67
142 Jameco .....	CV3	— Zagros Robotics .....	58

## ADVERTISING SALES OFFICES

**Gernsback Publications, Inc.**  
500 Bi-County Blvd.  
Farmingdale, NY 11735-3931  
Tel. 516-293-3000  
Fax: 516-293-3115

**Larry Steckler**  
Publisher (ext. 201)  
e-mail: advertising@gernsback.com

**Adria Coren**  
Vice-President (ext. 208)

**Ken Coren**  
Vice-President (ext. 267)

**Christina Estrada**  
Assistant to the Publisher (ext. 209)

**Marie Falcon**  
Advertising Director (ext. 206)

**Adria Coren**  
Credit Manager (ext. 208)

### For Advertising ONLY EAST/SOUTHEAST

**Megan Mitchell**  
9072 Lawton Pine Avenue  
Las Vegas, NV 89129-7044  
Tel. 702-240-0184  
Fax: 702-838-6924  
email: mmitchell@gernsback.com

### MIDWEST/Texas/Arkansas/Okla.

**Ralph Bergen**  
One Northfield Plaza, Suite 300  
Northfield, IL 60093-1214  
Tel. 847-559-0555  
Fax: 847-559-0562  
email: bergenrj@aol.com

### PACIFIC COAST

**Anita Bartman**  
Hutch Looney & Associates, Inc.  
6310 San Vicente Blvd., Suite 360  
Los Angeles, CA 90048-5426  
Tel. 323-931-3444 (ext. 227)  
Fax: 323-931-7309  
email: anita@hlooney.com

### Electronic Shopper

**Joe Shere**  
National Representative  
P.O. Box 169  
Idyllwild, CA 92549-0169  
Tel. 909-659-9743  
Fax: 909-659-2469  
email: joe@greencafe.com

**Megan Mitchell**  
National Representative  
9072 Lawton Pine Avenue  
Las Vegas, NV 89129-7044  
Tel. 702-240-0184  
Fax: 702-838-6924  
email: mmitchell@gernsback.com

### Customer Service

1-800-999-7139  
7:00 AM - 6:00 PM M-F MST



## MAIL-FAX OR E-MAIL YOUR REQUEST

**To insure a prompt reply, please furnish all requested information**

Address all editorial inquiries to Editor, Electronics Now, 500 Bi-County Blvd., Farmingdale, NY 11735-3931

# Electronics NOW®

4DCF2

Name \_\_\_\_\_ Title \_\_\_\_\_

Company \_\_\_\_\_

Dept. MS \_\_\_\_\_

Daytime Business Phone \_\_\_\_\_

Company Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip +4 \_\_\_\_\_

E-Mail Address \_\_\_\_\_

Unclear or incomplete mailing info will prevent our processing this request.

- 2 ☐ Please send me 12 issues (1 year) of **ELECTRONICS NOW** for \$24.99 and bill me. (Canada \$33.16 — US Funds only — Includes G.S.T.)
- 4 ☐ Please send me 12 issues (1 year) of **POPULAR ELECTRONICS** for \$19.99 and bill me. (Canada \$27.81 — US Funds only — Includes G.S.T.)

Please Respond by: August 31, 1999 Allow 6-8 weeks for delivery of first issue

31	60	89	118	147	176	205	234	263	292	321	350	
32	61	90	119	148	177	206	235	264	293	322	351	
33	62	91	120	149	178	207	236	265	294	323	352	
34	63	92	121	150	179	208	237	266	295	324	353	
35	64	93	122	151	180	209	238	267	296	325	354	
36	65	94	123	152	181	210	239	268	297	326	355	
37	66	95	124	153	182	211	240	269	298	327	356	
38	67	96	125	154	183	212	241	270	299	328	357	
39	68	97	126	155	184	213	242	271	300	329	358	
40	69	98	127	156	185	214	243	272	301	330	359	
41	70	99	128	157	186	215	244	273	302	331	360	
42	71	100	129	158	187	216	245	274	303	332	361	
14	43	72	101	130	159	188	217	246	275	304	333	362
15	44	73	102	131	160	189	218	247	276	305	334	363
16	45	74	103	132	161	190	219	248	277	306	335	364
17	46	75	104	133	162	191	220	249	278	307	336	365
18	47	76	105	134	163	192	221	250	279	308	337	366
19	48	77	106	135	164	193	222	251	280	309	338	367
20	49	78	107	136	165	194	223	252	281	310	339	368
21	50	79	108	137	166	195	224	253	282	311	340	369
22	51	80	109	138	167	196	225	254	283	312	341	370
23	52	81	110	139	168	197	226	255	284	313	342	371
24	53	82	111	140	169	198	227	256	285	314	343	372
25	54	83	112	141	170	199	228	257	286	315	344	373
26	55	84	113	142	171	200	229	258	287	316	345	374
27	56	85	114	143	172	201	230	259	288	317	346	375
28	57	86	115	144	173	202	231	260	289	318	347	376
29	58	87	116	145	174	203	232	261	290	319	348	377
30	59	88	117	146	175	204	233	262	291	320	349	378

# Electronics NOW®

4DCF2

Name \_\_\_\_\_ Title \_\_\_\_\_

Company \_\_\_\_\_

Dept. MS \_\_\_\_\_

Daytime Business Phone \_\_\_\_\_

Company Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip +4 \_\_\_\_\_

E-Mail Address \_\_\_\_\_

**Unclear or incomplete mailing info will prevent our processing this request.**

- 2 ☐ Please send me 12 issues (1 year) of **ELECTRONICS NOW** for \$24.99 and bill me. (Canada \$33.16 — US Funds only — Includes G.S.T.)
- 4 ☐ Please send me 12 issues (1 year) of **POPULAR ELECTRONICS** for \$19.99 and bill me. (Canada \$27.81 — US Funds only — Includes G.S.T.)

Please Respond by: August 31, 1999 Allow 6-8 weeks for delivery of first issue

2	31	60	89	118	147	176	205	234	263	292	321	350
	32	61	90	119	148	177	206	235	264	293	322	351
	33	62	91	120	149	178	207	236	265	294	323	352
	34	63	92	121	150	179	208	237	266	295	324	353
	35	64	93	122	151	180	209	238	267	296	325	354
	36	65	94	123	152	181	210	239	268	297	326	355
	37	66	95	124	153	182	211	240	269	298	327	356
	38	67	96	125	154	183	212	241	270	299	328	357
	39	68	97	126	155	184	213	242	271	300	329	358
	40	69	98	127	156	185	214	243	272	301	330	359
	41	70	99	128	157	186	215	244	273	302	331	360
	42	71	100	129	158	187	216	245	274	303	332	361
14	43	72	101	130	159	188	217	246	275	304	333	362
	15	44	73	102	131	160	189	218	247	276	305	334
	16	45	74	103	132	161	190	219	248	277	306	335
	17	46	75	104	133	162	191	220	249	278	307	336
	18	47	76	105	134	163	192	221	250	279	308	337
	19	48	77	106	135	164	193	222	251	280	309	338
	20	49	78	107	136	165	194	223	252	281	310	339
	21	50	79	108	137	166	195	224	253	282	311	340
	22	51	80	109	138	167	196	225	254	283	312	341
	23	52	81	110	139	168	197	226	255	284	313	342
	24	53	82	111	140	169	198	227	256	285	314	343
	25	54	83	112	141	170	199	228	257	286	315	344
	26	55	84	113	142	171	200	229	258	287	316	345
	27	56	85	114	143	172	201	230	259	288	317	346
	28	57	86	115	144	173	202	231	260	289	318	347
	29	58	87	116	145	174	203	232	261	290	319	348
	30	59	88	117	146	175	204	233	262	291	320	349



**To Order a New Subscription or  
To Renew an Existing Subscription  
Call 1-800-999-7139**

.20¢ POSTAGE  
REQUIRED IN  
U.S.A.

***Electronics*  
NOW®**

READER SERVICE MANAGEMENT DEPT.  
P.O. BOX 5192  
PITTSFIELD, MA 01203-9989

.20¢ POSTAGE  
REQUIRED IN  
U.S.A.

***Electronics*  
NOW®**

READER SERVICE MANAGEMENT DEPT.  
P.O. BOX 5192  
PITTSFIELD, MA 01203-9989



Call For Your Free  
Jameco Catalog!  
Mention VIP# 6R9

# JAMECO®

Since 1974

ELECTRONIC COMPONENTS

COMPUTER PRODUCTS

1•800•831•4242

Catalog  
992

[www.jameco.com](http://www.jameco.com)

1999

May - July



Electronics...

[jameco.com](http://jameco.com)



Order Now.

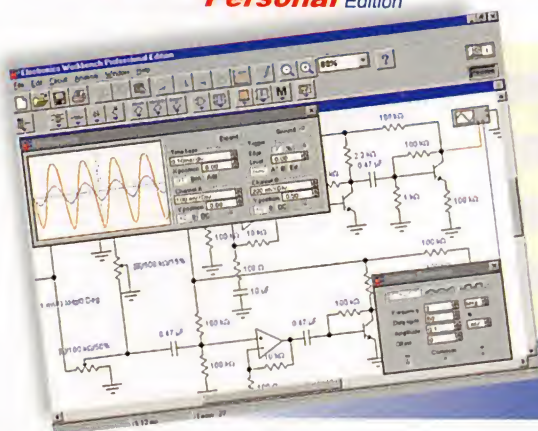
Jameco Electronics, 1355 Shoreway Road, Belmont, California, 94002

CIRCLE 142 ON FREE INFORMATION CARD



THE WORLD'S MOST POPULAR  
DESIGN TOOL CHOSEN BY OVER  
**100,000 USERS!**

## Electronics **Workbench** *Personal Edition*



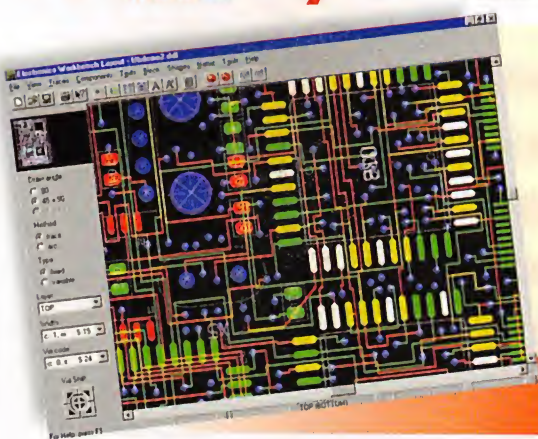
TRUE MIXED ANALOG/DIGITAL  
FULLY INTERACTIVE SIMULATION  
PRO SCHEMATIC EDITOR  
6 VIRTUAL INSTRUMENTS  
ON SCREEN GRAPHS  
OVER 4,000 MODELS  
8 POWERFUL ANALYSES  
FREE TECHNICAL SUPPORT

**\$299**

Full-featured schematic capture  
and SPICE circuit simulation!

The world's most popular circuit design tool that sets the standard for powerful, insightful SPICE simulation. Create professional looking schematics and then with the flick of a switch, display simulated waveforms live on a suite of virtual instruments. Includes 15 powerful analyses and a library of over 4,000 robust component models.

## Electronics **Workbench Layout** *Personal Edition*



AUTOROUTING  
REROUTE WHILE MOVE  
32 ROUTING LAYERS  
50" X 50" BOARD SIZE  
OVER 3,500 LIBRARY SHAPES  
EXTENSIVE OUTPUT  
REAL TIME DESIGN RULE CHECK  
DENSITY HISTOGRAMS  
FREE TECHNICAL SUPPORT

**\$299**

Power-packed PCB layout with  
autorouting and real-time DRC!

EWB Layout is a powerful board layout package for producing high-quality, multi-layer printed circuit boards. Offering tight integration with our schematic capture program, EWB Layout is the best way to quickly produce well-designed boards.



**BUY BOTH AND SAVE! ~~\$598~~ \$548**

CALL FOR INFORMATION  
AND PRICING ON OUR  
PROFESSIONAL EDITION.

**800.263.5552**

**30-DAY MONEY-BACK GUARANTEE**

Fax: 416-977-1818

E-mail: [ewb@interactiv.com](mailto:ewb@interactiv.com)



For a free demo, visit our website at [www.electronicsworbench.com](http://www.electronicsworbench.com)